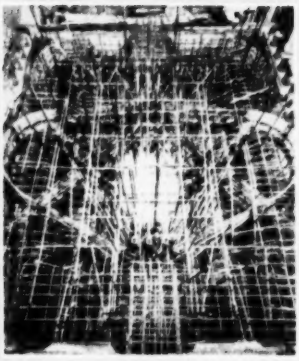
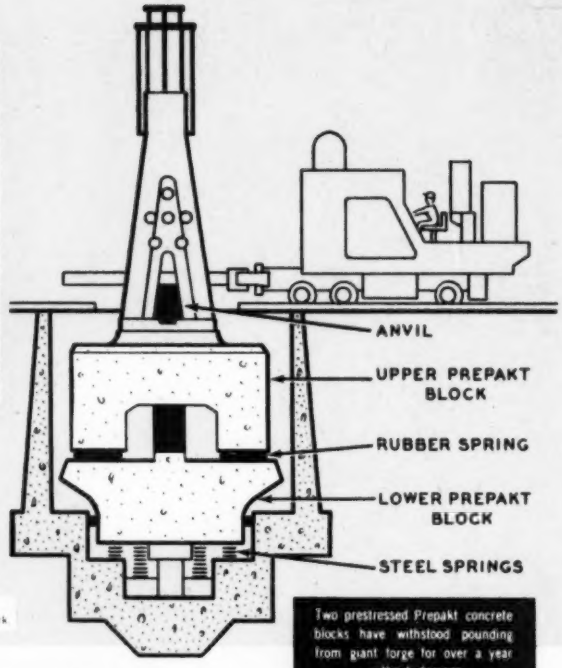
ACI News Letter -

Vol. 24, No. 8 JOURNAL of the AMERICAN CONCRETE INSTITUTE April 1953



Prepakt method is simplest for placing concrete around intense reinforcement. Preplacing aggregate, then pumping voids completely full with Intrusion mortar produces high-strength, monolithic block.



Two prestressed Prepakt concrete blocks have withstood pounding from giant forge for over a year without damage

Designed by: J. H. A. Crockett, Consulting Engr., London. Tech. Supr. Construction: A. M. Klein, Robert W. Hunt Co., New York.

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To minimize maintenance and avoid fatigue failure, the blocks had to be super-strong, homogeneous concrete. This was achieved by Prepakt methods of preplacing inert coarse aggregate and then pumping voids full with Intrusion mortar. These techniques eliminated segregation and cold joints—and produced exceptionally high-strength structures with less cement.

Compression strength tests (on job-made cylinders) showed 4000 psi at 6 days; 5700 psi at 27 days; *10,600 psi* at 180 days; *and 12,933 psi at one year!*

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ACI

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April 1953

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Technical Program Offers Wide Variety at Boston Convention

New developments, construction practice, design, and research highlight crowded sessions

Boston played host to 804 ACI members and their wives and visitors who attended ACI's 49th annual convention, Feb. 16-19, at the Hotel Statler. This was the largest registration in ACI history with the exception of the Denver convention in 1948 which drew 886. The only previous meeting in New England was the regional meeting in Boston in 1949.

A crowded technical program attracted large audiences. Included were sessions on vibration of concrete, design, thin-shell precast concrete, the annual open session of ACI Committee 115–Research, and a panel discussion on concreting problems. Technical subjects covered in general sessions included various aspects of current interest: building foundations on soft ground, measurement of compressive stress, a ten-year report on the Long-Time Study of Cement Performance in Concrete, construction specifications, structural refractory concrete, radiation shielding, fly ash, correlation between laboratory freezing and thawing and weathering, and Guniting.

ACI technical committees presented two new Standards for discussion and proposed revision of one other. In addition the new ACI-PCA film "Quality Concrete" on proper techniques in making good concrete was previewed.

An innovation at this year's convention was the devoting of one full day, Feb. 16, to technical committee meetings. More than 15 committees and subcommittees met to discuss various technical aspects of concreting and plan future committee activities. (An annual review of committee activities will be published in the May "News Letter.")

The session on vibration of concrete featured reports of laboratory tests and the effect of vibration on air content of mass concrete. Vibration of mass concrete; application of vibration to concrete pavement construction; vibration practices in pipe, precast, and block manufacture; and vibration practices in structural work also received attention.

Continued on p. 4

The design session covered such topics as limit analysis and design, design equations for ultimate strength, stability of thin-shell structures, yield-line theory for the ultimate strength of reinforced concrete slabs, and static and dynamic behavior of reinforced concrete beams.

The thin-shell precast concrete session featured papers on site fabrication of thin-shell ribbed panels in plastic molds, factory production of thin-shell ribbed panels, thin-shell ribbed panels for roof framing, precast buildings for ammunition storage, and fabrication and erection of precast enclosure framing for one-story barracks.

Lighter portions of the convention program included the annual Awards Luncheon and a New England lobster dinner, provided with the compliments of the New England concrete and building industry, engineers, and the local Boston convention committee. Members' wives were not forgotten either, with the local committee offering an excellent program for the ladies' entertainment.

The majority of the papers presented at the Boston meeting, if they have not already appeared in the ACI JOURNAL, will be published in later issues.

Standard on precast concrete floor units revised

The opening session, Tuesday, Feb. 17, with President A. T. Goldbeck presiding, considered proposed Standards, revision of Standards, ACI publications, and a preview of the motion picture "Quality Concrete."

Precast concrete floor units

The convention approved a report from Committee 711 for revision of "Minimum Standard Requirements for Precast Concrete Floor Units (ACI 711-46)." The revision has now gone to ACI membership for a secret letter ballot to be canvassed May 27.

The revision changes the 1946 Standard by adding descriptions of assembled concrete block, precast inverted T-beam joist with precast filler block, and inverted precast slab and T-joist types of floor units. New information was incorporated on moment bar spacing, steel requirements, distance between lateral supports, and provision for tests (see ACI JOURNAL, Nov. 1952, p. 169).

George C. Hyland, commissioner of public works, welcomes ACI to Boston

Reinforced concrete chimneys

A new Standard, "Proposed Standard Specifications for the Design and Construction of Reinforced Concrete Chimneys," (ACI JOURNAL, Jan. 1953, p. 353) was presented by Committee 505 as a replacement for the ACI Tentative Standard 505-36T.

It was the intent of the committee to recommend to the 49th annual convention the adoption of this report as a standard specification, subject to the results of a letter ballot of the full membership in accordance with Institute practice. However, since the JOURNAL containing the report did not reach the membership prior to the convention, Committee 505 felt that the convention should not be asked to take any action on a report which the members had not had an opportunity to read or consider. Therefore, E. A. Dockstader, chairman of Committee 505, moved that the report be laid on the table for one year and be presented to the 50th annual convention for action, with any revisions which the committee may recommend in the interim. The motion was carried and the proposed Standard will be considered at the Denver convention in 1954.

In presenting the report of Committee 505, Mr. Dockstader gave a brief review of the history of reinforced concrete chimneys and the contributions of the Institute to the improvement of this type of structure. The

construction of reinforced concrete chimneys began in the early 1900's, about the time of the founding of ACI. This type of chimney proved economical and grew in popularity, particularly since deterioration and high maintenance due to inadequacies in design and construction developed slowly.

About 35 years ago, Mr. Dockstader said, it was the practice in some of the leading companies engaged in concrete chimney construction to design on the basis that the chimney shell was a homogeneous hollow circle, determine the maximum tension from an assumed wind pressure on 1 sq ft on the basis of My/I about a gravity axis through the center of the chimney, provide vertical reinforcing steel to take this tension and to duplicate this reinforcing in every square foot around the periphery of the concrete chimney shell. No attention whatever was paid to temperature effects or any other design features. Circumferential reinforcing was provided purely on the basis of judgment, frequently in the form of a light triangular mesh often placed too close to the outside of the concrete. With time, cracks appeared due to inadequate design, the reinforcing rusted, the concrete spalled, requiring difficult and expensive maintenance, and reinforced concrete chimneys began to be in disrepute.

In 1922, at the 18th annual convention of the Institute, Committee S-1, Eric Plagwit, chairman, submitted "the substance of a specification for the design and construction of tapering reinforced concrete chimneys." The design section occupied one printed page of the *Proceedings* and consisted of the statement of eight items of primary assumptions, six items of allowable stresses, and two general statements. The balance of the report dealt with materials, mixing, and placing. In a discussion of this report, John Lowell, a member of Committee S-1, pointed out the importance of temperature, outlined a basis for computing temperature effects, but stated that practically no data were available to determine the magnitude of the temperature drop through the chimney shell. Committee S-1 continued to work on the problem under the chairmanship of Mr. Plagwit through 1925; then under the chairmanship of C. E. Nichols through 1929, at which time all technical committees of the

A. T. Goldbeck, left, retiring as ACI president, congratulates Henry L. Kennedy upon his election to the post

Institute were disbanded and a new type of committee organization was adopted.

While more than one progress report was made during this period, no specification was reported. However, Mr. Dockstader said, important data developed in this period. Provision was made in the construction of a reinforced concrete chimney at New Bedford, Mass., in 1922 to measure the temperature drop through the chimney shell at both unlined and lined sections when the chimney was in service. A paper giving the results of these tests was presented at the 1925 ACI convention by Mr. Dockstader. Provisions for still more elaborate tests were made in a chimney constructed in 1926 at Duluth, Minn. and a paper by Earle D. McKay giving the results of these tests was presented to the Institute in 1927.

In 1930, the reorganized Committee 505, under the chairmanship of Mr. Dockstader, began work on a proposed standard specification for the design and construction of reinforced concrete chimneys. This committee developed definite methods for determining the stresses due to dead load, wind, and earthquakes, as well as vertical and circumferential stresses due to temperature. Methods for the combination of these stresses and maximum allowable stresses were set forth. The report was published by the Institute in 1934 and adopted as a tentative standard specification, 505-36T, at the 1936 convention. This specification has continued in active use for more than 17 years, and despite many inadequacies, Mr. Dockstader said, has formed the basis for the design and construction of a large majority

Text continued on p. 8

MEMORIAL*

Harvey Whipple

(1884-1952)

It was with a sense of real, personal loss that we, the members of the Board of Direction, American Concrete Institute, learned of the passing, on Sept. 6, 1952, of Harvey Whipple, long-time Secretary-Treasurer of the Institute. It was only last July that Harvey had retired after a period of active service for the Institute which had extended without interruption for almost a third of a century. It was hoped that he would continue to serve for many years longer as editorial consultant and his death occurring so shortly after retirement came as a distinct shock to his many friends and associates.

Of early New England stock, "Mr. ACI," as he had come to be known, was born at Ovid, Mich., on Aug. 2, 1884. His ancestral home was the Massachusetts town of Ipswich and it is interesting to note that the old "Whipple House," home of Harvey's great uncle, several times removed, still stands in that historic town. As past president Arthur Lord once well said, "Harvey's success in the administration of ACI affairs was due in no small degree to his passion for truth as opposed to 'innuendoes and shady whisperings,' a heritage springing from his combined New England and Michigan background."

Harvey early displayed an interest in journalism. After a short period as a reporter on the *Detroit News* and the *Detroit Free Press*, he joined the staff of *Concrete and Cement Age* (later

*Adopted by the Board of Direction, Feb. 17, 1953.

Concrete) in 1910, first as associate editor and later as editor-in-chief. It was in this latter capacity that he became interested in the National Association of Cement Users, the forerunner of ACI. In 1919, he took over the direct management of ACI affairs, the tenth man to succeed to that position in about that number of years. In the words of H. J. Gilkey, the others "have been lost in the past." The memory of Harvey Whipple will be with us for a long time.

During his 32-year term as Secretary-Treasurer, Harvey Whipple saw the status of our organization raised from what in reality amounted to a restricted trade group to that of a great national professional society. During this period, he saw our membership grow from a little over 300 to almost 6000. He was largely instrumental in establishing the JOURNAL in 1929, becoming its first and only editor until his retirement in 1952. It is true that much of the Institute's growth has been due to the outstanding leadership and wise council of many of those who have served both as president and in other positions of authority. However, after granting all this, the fact remains that it was Harvey to whom the job of actually running the Institute (sometimes in the early days with a very inadequate staff) was intrusted. It was his job to mold into a continuous forward looking policy the sometimes conflicting ideas of succeeding elected officials. Events have shown that he was eminently fitted for the task.

Harvey Whipple's interests were by no means confined to concrete. Among his extra-curricular activities was the growing of special varieties of iris to which he devoted a considerable portion of his spare time.

On a plain slab over the grave of Sir Christopher Wren in St. Paul's Cathedral, one may read the following inscription:

"Reader, if you seek his monument look around."

The organization which Harvey Whipple bequeathed to those of us who follow is the most impressive and most fitting monument which could have been erected to his memory.

BE IT THEREFORE RESOLVED: That this memorial to the life and services of Harvey Whipple be sent to his family with an expression of the sincere sympathy of the members of the American Concrete Institute; that it be published in the ACI JOURNAL; and that it be duly spread upon the Minutes of the Institute's Board of Direction.

of the reinforced concrete chimneys constructed in this country during this period.

The committee was reactivated in May, 1949, under the chairmanship of Mr. Dockstader, to bring the tentative standard up to date. The tentative standard specification has been completely rewritten and rearranged, although the basic methods of analysis and design are essentially unchanged.

The tentative specification dealt with the stresses due to earthquakes on the basis of cantilever action of the mass of the chimney above any horizontal section. Experience has indicated that this procedure provides adequate strength and stiffness for the lower fifth of a chimney, but that the upper portion of chimneys designed on this basis may develop cracks when subjected to earthquake forces. This presumably is due to whipping action, and the revised specification gives a method of determining the stresses in the upper four-fifths of a chimney on an empirical basis.

The most important revision, noted Mr. Dockstader, is with respect to the temperature gradient through the concrete chimney shell. This matter baffled every Institute committee that had grappled with it, primarily because of the lack of experimental and test data. The tentative standard dealt with it in a very broad way, specifying one over-all constant for unlined chimneys and another over-all constant for lined chimneys, regardless of the type of lining. In revising the specification, Committee 505 studied the subject using theoretical heat transfer balance as a basis, together with test data, and has extended the specifications to cover varying kinds and thicknesses of linings, with both unventilated and ventilated air space between the lining and the chimney shell.

Mr. Dockstader emphasized that both the tentative standard and the present proposed specification were written on the basis that it is advisable to include a definite method for determining the more important stresses in a reinforced concrete chimney with definite limits for the stresses so determined, even though the accuracy of the method of determination may be subject to further study and the value of specified constants may well be subject to the results of further experimental and test data.

Manual of Standard Practice for Detailing Reinforced Concrete Highway Structures

Raymond C. Reese, chairman of ACI Committee 315, reported upon the status of the "Proposed Manual of Standard Practice for Detailing Reinforced Concrete Highway Structures," covering its purposes and history, and describing it briefly. The manual, which will be a companion piece to the present *Manual of Standard Practice for Detailing Reinforced Concrete Structures* (*ACI 315-51*), presents improved methods of preparing drawings for the fabrication and placing of reinforcing steel in reinforced concrete highway structures. The use of these methods will result in better construction and also simplify and reduce the amount of work ordinarily required to prepare such drawings, noted Mr. Reese.

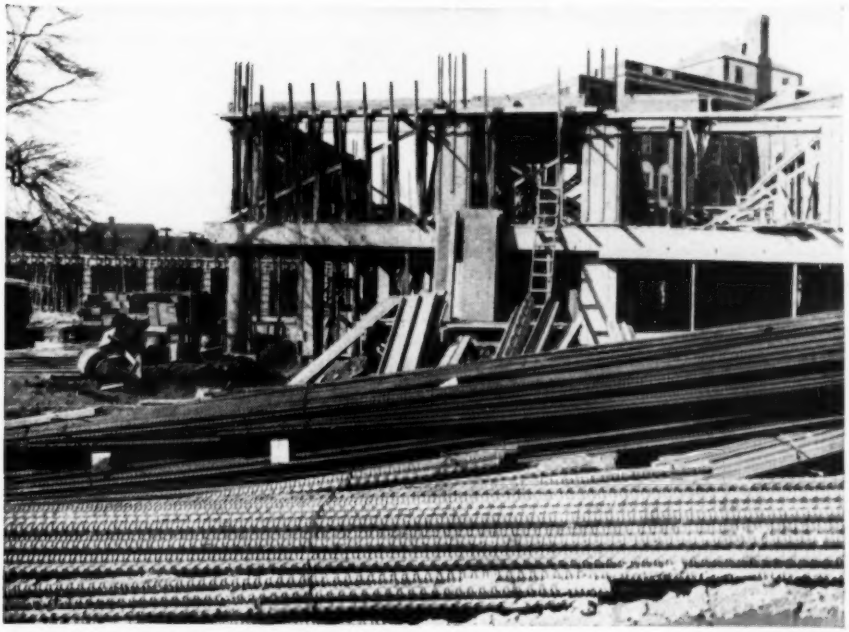
It had been the intention of Committee 315 and also the Technical Activities Committee that the proposed manual would be presented to the 49th annual convention for adoption as an Institute Standard. However, since the proposed manual did not reach the ACI Standards Committee in sufficient time for evaluation, special procedure was proposed by the Technical Activities Committee and the ACI Board of Direction.

In discussing the special procedure, Douglas McHenry, chairman of the Technical Activities Committee, noted that the Bylaws of the Institute contained the following statement (Article V):

"The Board of Direction shall adopt such rules and regulations governing the procedure for the consideration and adoption of Standard Specifications, Standard Practice Recommendations, and Standard Definitions as will safeguard their soundness and representative character."

Acting in conformance with that article of the Bylaws, the Board of Direction recommended that the following motion be placed before the convention:

"If the *Manual of Standard Practice for Detailing Reinforced Concrete Highway Structures* is approved and released by the Standards Committee, a description of the manual shall be published in the JOURNAL, and when 60 days have elapsed subsequent to such publication to permit discussion, Institute members are to be polled by secret



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ballot on the question of adopting the manual as an Institute Standard."

The motion was carried unanimously by the members present at the general session.

Manual of concrete inspection

Roderick B. Young, a member of Committee 611, discussed briefly changes to be incorporated in a proposed new edition of the *Manual of Concrete Inspection.* Some 20,000 of the original edition have been distributed by the Institute, and the committee expects revisions to the manual to be completed in the near future. Mr. Young said that the chief feature of the revision is a general re-examination and filling in of explanatory matter to be of greater use to the inspector.

He noted that the committee hoped "that the revised manual will create new interest in the problem of inspection. We hope that more architects and engineers will be willing to spend the money for proper inspection, and hope more inspectors will get over the idea that they are policemen and will be more cooperative." Mr. Young felt that the whole status of inspection could be raised if there were more cooperation between all parties concerned.

From far and wide

While naturally the Boston area provided the largest group attending the 49th annual convention, 30 other states, District of Columbia, Canada, Cuba, and Australia were represented. L. Boyd Mercer, Melbourne, Australia, had no difficulty in receiving the unofficial title of "globe trotter."

Mass.	360	Colo.	6
N. Y.	81	Ind.	6
Canada	74	Md.	6
Ill.	37	Mo.	6
Ohio	31	Iowa	3
D. C.	29	Minn.	3
Pa.	27	Miss.	3
Mich.	22	Cuba	2
N. J.	20	Fla.	2
Calif.	13	Kan.	2
Conn.	10	N. C.	2
Maine	9	Okla.	2
Texas	9	Wash.	2
Wis.	9	Del.	1
N. H.	8	La.	1
R. I.	8	Neb.	1
Va.	7	Tenn.	1
Australia	1		

Motion picture previewed

Final item on the morning program was a preview of the new ACI-PCA film "Quality Concrete" on proper techniques in making quality concrete. The film was introduced by Prof. James A. McCarthy, University of Notre Dame, chairman of the ACI Film Advisory Committee which passed on the technical details of the film. He reviewed briefly the activities of ACI in relation to the use of motion pictures as a means for disseminating information on concrete construction.

At a Board meeting in 1949, Raymond Davis recommended that the Institute disseminate information on concrete and concrete construction by the use of motion pictures. A special committee under the chairmanship of Harmer E. Davis was formed to consider ways, means, and possibilities for the Institute to assist in such an achievement. In 1950, an ACI committee on visual education, under the chairmanship of Harry F. Thomson, suggested the possibility of a joint effort with the Portland Cement Assn. In 1951, Frank T. Sheets, president of PCA, and ACI President Frank H. Jackson developed this cooperation, which resulted in the formation of a program during the term of ACI President Harry Thomson.

An ACI Film Advisory Committee was appointed in 1952, with George H. Miller, Austin Co., Chicago, Ill.; Prof. K. B. Woods, Purdue University, Lafayette, Ind.; and Professor McCarthy as chairman. This committee cooperated with representatives of the Portland Cement Assn., W. G. Kaiser, chairman, H. L. Flodin, C. Zeigler, and C. C. Oleson.

Early in the operation it was decided to direct the information to be offered by the film to an intelligent but inexperienced undergraduate engineer or to an interested field engineer engaged in concrete construction who may not have had the opportunity of acquiring this information elsewhere.

Two films were proposed, the first, on the making of quality concrete, and the second, on the transportation, placing, finishing, and curing of quality concrete. The second film is now in the process of preparation.

The film previewed at the Boston convention, "Quality Concrete," is now available through the 32 national district offices of the Portland Cement Assn.

$200 per cu yd concrete for jet engine test cells

Development of the jet aircraft engine is changing not only the future of aviation but also affecting many tangential fields, including the concrete industry. Aircraft engines require testing during development and production. Such tests are normally conducted within concrete structures, comprising among other components, an exhaust stack which serves to attenuate the engine's roar and direct the exhaust gases skyward. Since jet engines can raise the temperature within the structure from room temperature to 1200 F in 8 sec, special refractory concrete is needed to withstand the deteriorating effects of heat, temperature shock, and cycling.

The problems in constructing such structures were reported in detail by Herman G. Protze, consulting technologist on concrete and construction materials, Boston, at the afternoon session, Tuesday, Feb. 17. Session chairman was Henry L. Kennedy.

Durable structural-refractory lightweight concrete has been developed using aluminous cement and artificial aggregates. Aggregates manufactured by sintering or burning in a kiln certain types of clay or shale to cause expansion are the most dependable, said Mr. Protze. In-place cost of the concrete has varied in the current market from $155 to $205 per cu yd.

Mr. Protze emphasized that all materials should be kept at as low a temperature as practicable during mixing and placing. Even greater care should be taken to keep that portion of the forms in contact with the concrete at a low temperature, preferably under 40 F. On the projects described, water sprays were used for cooling the forms and continued after stripping of forms until the concrete had passed the peak hydration temperature.

Building foundations

The afternoon program also included a review of various methods for controlling building settlements on soft ground—"Building Foundations on Soft Ground," by Prof. Arthur Casagrande, Harvard University, Cambridge, Mass. The control of differential settlements by means of stiff foundations, in particular the use of reinforced concrete girders, was discussed and illustrated by examples of large buildings in Boston, New Orleans, and Mexico City. Semi-empirical rules for the design of such foundation girders were suggested and illustrated by descriptions of the design of rectangular concrete tanks for oil storage.

Long-Time Study

Undoubtedly one of the more important reports presented at the Boston meeting was the "Ten-Year Report on the Long-Time Study of Cement Performance in Concrete," prepared by the Advisory Committee of the Long-Time Study and presented by Frank H. Jackson, Bureau of Public Roads, Washington, D. C.

Primarily, this study was undertaken to determine whether any relationship exists between the composition, fineness, and conditions of manufacture of the test cements and the ability of the concrete in which they were used to resist disintegration when subjected to external influences, such as water, sulfate solutions, temperature changes, and highway traffic with or without the application of salts for ice removal.

The investigation was set up to study the behavior of the test cements in concrete structures subjected to the full range of exposures encountered in the United States. The following projects were chosen as being representative of the types of construction in which performance of cement was of greatest importance: (1) roads in severe, moderate, and mild climate; (2) test specimens in sulfate soil in mild climate; (3) piling exposed to sea and fresh water, severe and mild climate; (4) thin to moderate size concrete sections exposed to severe natural weathering; (5) specimens of "near job-size" in test plots located in severe and mild climates. Exposures at these projects were of two types: first, normal weathering encountered at the project, mild in some locations, severe in others; and second, exposure to special conditions involving the action of chemicals, such as sulfate soil, salt and sea water, or salts used on pavements for ice control.

Most of the test structures have now been exposed to weathering for ten years, and

Everyone (or almost) has their "bib and tucker" on for the big New England lobster dinner.

this report presented the most important facts regarding the cements and their performance to date. Mr. Jackson reported that no consistent relation was found between the composition and fineness of the cements and the behavior of concrete exposed to freezing and thawing. For cements within the usual range of composition and fineness, normal differences in manufacturing procedures and conditions did not appear to be significant with respect to the durability of concrete made with them.

The resistance of concrete to attack by solutions of sulfate salt was reported to increase with reduction of potential C_3A content in the cement. Substantiating other studies, the evidence was strong that air entrainment greatly increases the ability of concrete to endure freezing and thawing without deterioration, and was found to be particularly effective in preventing scaling when chlorides are used for ice control on concrete pavements. It is intended, said Mr. Jackson, that the Long-Time Study of Cement Performance in Concrete be continued for many years, and it is recognized that future observations and studies may modify, at least in some degree, any conclusions drawn at this time (the full report is contained in the ACI JOURNAL, Mar. 1953, p. 601).

In discussing the paper, Harmon S. Meissner, U. S. Bureau of Reclamation, Denver, Colo., emphasized the need for Type V cement in producing concrete that would be resistant to sulfate conditions. A. Allan Bates, Portland Cement Assn., Chicago, Ill., in discussing types of cement, noted that the Corps of Engineers had more faith in Type II cement than Type I because they felt that the greater complexity of Type II specifications gave them better assurance of uniformity. However, various tests have shown that there is frequently a greater range in performance between various Type II cements than among Type I cements. This point stands out in bar graphs shown relative to the Long-Time Study cements. He said that this indicates that the uniformity seemingly built into Type II cement by

The local convention committee played host for the affair, served by the Hotel Statler in Boston

additional specifications is superficial and actually results in no greater uniformity in the final field performance.

Measurement of compressive stress

"Development of a Device for the Direct Measurement of Compressive Stress," was described by Roy W. Carlson, consulting engineer, Berkeley, Calif.; co-author of the paper was David Pirtz, University of California, Berkeley. Mr. Carlson discussed the development, analysis, and testing of a device called the "stress meter." He showed that it is possible to make an embedded device which at all times registers very nearly the same stress as the surrounding concrete, regardless of the deformation. Tests have shown that stress meters embedded in a concrete specimen were practically insensitive to creep under sustained load, and maintained the same zero stress reading when the specimen was subjected to a variety of conditions. The stress meters also indicate very nearly the correct stress when loaded at various ages, although the modulus of elasticity of the concrete changes markedly. (The full report is contained in the Nov. 1952 JOURNAL, p. 201.)

The application of these stress meters was then discussed by Herbert K. Cook, Concrete Research Division, Waterways Experiment Station, Jackson, Miss., and Byram W. Steele, consulting engineer, Arlington, Va.

"The Corps of Engineers, in connection with the construction of large dams, is of course, vitally interested in a successful stress meter," said Mr. Cook. He said that testing of the meter described by Mr. Carlson had just been started at the Waterways Experiment Station, and described these investigations briefly. He said that the test data was not yet available but hoped that they would bear out the promising nature of this meter.

Construction specifications

"Recent Changes in Concrete Construction Specifications for the Corps of Engineers, Department of the Army," designed to give the taxpayer more for his money—better

structures for specific utility at less cost—were explained by Woodrow L. Burgess, Concrete Control Branch, Office, Chief of Engineers, Department of the Army, Washington, D. C.; co-author was George L. Otterson of the same organization.

"A structure is built economically with cheap materials and methods only if those materials and methods result in a structure of full utility and purpose. On the other hand, the use of expensive materials and methods can result in an economical structure only if their performance outweighs the maintenance or replacement cost that would result from the use of less expensive materials and methods," emphasized Mr. Burgess.

He described briefly the Corps of Engineers documents which contain concrete construction policies of that organization. A recent change is the preparation of two guide specifications permitting the selection of provisions best adapted to the project, and aimed at greater uniformity in similar jobs. He then described control measures for aggregate gradation, particle size, and uniformity; type of cement used; limits for air entrainment; curing; and various other control measures. (The full report is published on page 721 of this month's JOURNAL.)

Motion pictures shown at evening session

Something new for ACI conventions was the evening session, Tuesday, Feb. 17, devoted to motion pictures on concrete construction and related topics.

"Operation Concrete," produced by the Portland District, Corps of Engineers, Department of the Army, Portland, Ore., described the exploration and development of aggregate sites, aggregate processing, and the cooling plant necessary for the large volume of mass concrete placed at Detroit Dam. "Prefabrication of Prestressed Concrete Roof Joists," by the Hydro-Electric Power Commission of Ontario, Toronto, Canada, showed the construction techniques used in erecting a building for the Commission. Where 18 tons of steel beams would have been necessary to construct the building, only 6 tons of steel were needed by utilizing prestressed concrete roof joists.

"We Call it Big Creek," a film by the Southern Edison Co., Los Angeles, described the development of hydroelectric facilities on Big Creek in California. "Keep Progress Rolling in Texas," a production of the Texas Good Roads Assn., showed the effect of heavy traffic on inadequate roads and made a plea for the allocation of more funds to the extension of the road network.

Bengt F. Friberg, consulting engineer, St. Louis, Mo., presented a film on "Floor and Concrete Frame Construction in Air Force Dormitories." An Atomic Energy Commission film, "Operation Greenhouse," described the technical set-up for atomic tests at Eniwetok Island and showed the effect on sample types of building.

Symposium on vibration of concrete

One complete session was devoted to various aspects of vibration of concrete, including laboratory tests, effect of vibration on air content, and vibration practices in mass concrete construction, concrete pavement construction, pipe, precast and block manufacture, and structural work. Under the chairmanship of Prof. Charles H. Scholer, Kansas State College, Manhattan, the Wednesday morning session was held concurrently with the one on design. Committee 609—Compaction of Concrete by Mechanical Means, sponsored the session, and Harmon S. Meissner, Bureau of Reclamation, Denver, Colo., chairman of Committee 609, served as the session leader.

Compacting concrete by vibration

In presenting the introductory paper, "Compacting Concrete by Vibration," Mr. Meissner noted that vibration compaction is one of the more important advances in concrete technology. The advantages of compacting concrete by vibration include lower cost of concrete through ease of placement, and by reduced cement content; greater density and homogeneity in the concrete; greater strength; improved bond with reinforcement; greater bond at construction joints; greater durability; and reduced volume change form shrinkage. The savings achieved and the improved qualities in the concrete are now so well established, said Mr. Meissner, that vibration has become an accepted practice in practically all types of concrete work.

"Although the practice of vibration has been well established for 20 years, and many types of equipment have been evolved to compact concrete by this method, there yet remains a great deal to be learned about the basic principles involved, so that vibrators may perform efficiently," said Mr. Meissner.

Laboratory tests on vibration

Test results seem to indicate that the strength of hardened concrete increases with the time of vibration, so long as the deformability also becomes greater. Furthermore, it appears that the shrinkage is relatively independent of the time of vibration, as reported in "Laboratory Tests on Vibration of Concrete," by Sven G. Bergstrom, Swedish Cement and Concrete Research Institute, Stockholm, Sweden. In the absence of Mr. Bergstrom, Eric Fridh, Vibro-Plus Corp., Woodside, Long Island, N. Y., presented the paper.

The paper was a brief survey of tests conducted at the Swedish Cement and Concrete Research Institute. It described a novel experimental apparatus for registering and determining the effects of vibration on fresh concrete. In the main, these tests can be classified in three groups: first, the study of pressures, deformations, and consumption of energy in fresh concrete subjected to internal vibration; second, the study of the effects produced by vibration on the properties of fresh concrete; and third, the study of the effects of vibration on the properties of hardened concrete. The latter two investigations are still in progress, and the author presented tentative conclusions.

Results from the first group of tests indicate that the radius of action of the internal vibrator decreases as the consistency of the concrete becomes stiffer, and as the acceleration or the velocity of the vibrator becomes smaller. The energy consumption per unit volume for fully compacted concrete increases as the radius of action decreases.

Studying the effects of vibration on the properties of fresh concrete, deformability of the fresh concrete and time of vibration exhibited three distinct periods: compaction period, a stable period, and a segregation period.

Effect of vibration on air content of mass concrete

The air content of mass concrete can be seriously affected by improper use of either a high-frequency or a moderate-frequency vibrator, was the warning contained in the paper "Effect of Vibration on Air Content of Mass Concrete," by W. O. Crawley, Concrete Research Division, Waterways Experiment Station, Jackson, Miss. The author also warned that severe coarse aggregate segregation and uneven air distribution and loss can occur when the vibration period is as long as 90 sec, if the vibrator is held in the same position.

A. T. Goldbeck and Franklin R. McMillan (l. to r.) discuss concrete problems with the man who traveled the farthest to attend the convention, L. Boyd Mercer, Melbourne, Australia

The paper reported results of tests made to observe the effect of high-frequency (13,000 vpm) and moderate-frequency (6800 vpm) vibration on concrete ranging from ½ to 4-in. slump, containing 6-in. coarse aggregate, and having nominal air contents of 3, 6, and 9 percent in that portion of the mix smaller than the 1½-in. sieve.

The high-frequency vibrator was found to cause more rapid loss of entrained air than the moderate-frequency vibrator. However, either vibrator would cause a 50 percent loss in air from nominal 3 percent air content concrete in 30 sec. The rate at which air was lost generally increased with slump, but not to a marked degree. The high-frequency vibrator had more effect in causing movement and escape of air, while the moderate-frequency vibrator caused more movement and segregation of the coarse aggregate.

Vibration of mass concrete

"Modern equipment for vibration of concrete has revolutionized our concepts of mass concrete and has greatly extended the limits of economy that can be obtained with it,

Mr. and Mrs. Roderick B. Young (elected to honorary membership), left, and Franklin R. McMillan (recipient of Alfred E. Lindau Award) chat outside the banquet hall

Photo courtesy Pit and Quarry

without loss of quality," said Lewis H. Tuthill, Bureau of Reclamation, Denver, Colo., in his paper "Vibration of Mass Concrete." It has completely changed our concept of what is practical and desirable as a mass concrete mix, he said. Together with air entrainment, it has made mixes of low cement content placeable with reductions in unit water content up to 80 lb per cu yd.

Other improvements in quality or in cost, or both, can result when full advantage of vibration is taken to place mixes with larger aggregate in many cases where there is reinforcing, to place concrete in thicker layers, to permit use of larger buckets, and to eliminate poor bond at cold joints.

Pavement construction

The general acceptance of vibration as a method of consolidating pavement concrete has not kept pace with its acceptance in other fields, said A. G. Timms, Bureau of Public Roads, Washington, D. C., in the paper "Application of Vibration to Concrete Pavement Construction." Very few of the state highway departments have as yet adopted the method as standard practice in pavement work, although it is generally used in bridge construction.

Internal vibration has replaced hand spading to a large degree. Pavement specifications in use in 28 states require the use of internal vibrators along the joints and forms, and in 12 additional states their use for this purpose is optional with the contractors. It is the consensus of construction engineers, said Mr. Timms, that the use of internal vibration reduces labor costs and produces better surfaces with less honeycomb adjacent to the forms than the older method of spading. However, he warned, excess use of internal vibration may cause segregation in the fresh concrete and thus produce concentrations of mortar with high water contents.

Full width vibration is a requirement in the specifications of only five states; however, it is optional with the contractor in 11 other states.

In Mr. Timms' opinion, the placing of pavement concrete by full width vibration will never be completely successful in this country until a new start is made in designing forms or other means of supporting the equipment, in writing and enforcing specification requirements that will insure little variation in the materials for the concrete, in employing mixers that will mix and discharge 0 to 1-in. slump concrete, and finally, in using vibrator equipment with sufficient power and efficiency to insure close compaction of the concrete.

Pipe, precast and block manufacture

In the manufacture of various concrete products, form vibrators are most frequently used, although internal and surface vibrators are also employed, said Prof. G. W. Washa, University of Wisconsin, Madison, in his paper "Vibration Practices in Pipe, Precast, and Block Manufacture." In addition to vibration, various methods of tamping, pressing, jolting, rolling, and spinning also provide ways of obtaining desired compaction and satisfactory placement. These various methods are used to manufacture a wide variety of precast concrete products, such as block, brick, slabs, roofing tile, irrigation pipe, sewer pipe, joists, and others.

While form vibrators are not as efficient as internal vibrators, in the sense that some of the energy of the form vibrator is absorbed by the form, said Professor Washa, nevertheless they are widely used because of their convenience and adaptability.

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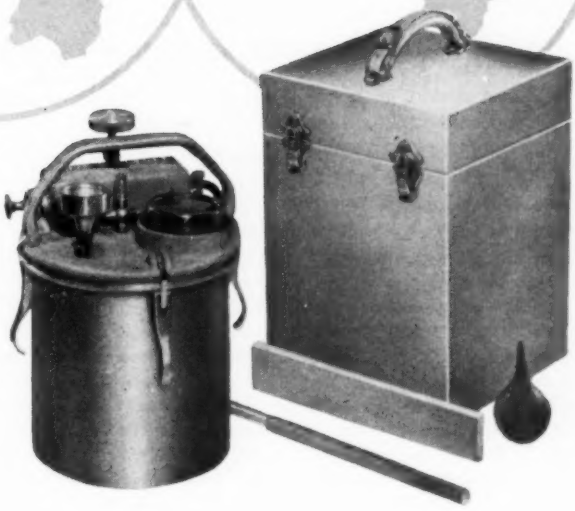

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Although various techniques are used in concrete block and pipe manufacture, the greatest variation in placement practices is found in the manufacture of the varied products made by the precast concrete products industry, he said. Plastic concrete may be hand rodded or internally vibrated. Stiff concrete may be placed by hand ramming, machine tamping, form vibrators, hydraulic pressing, machine rolling, or jolting. Vibration practices vary over a wide range, and are usually determined, he said, by each manufacturer for the particular equipment he has available and the requirements of his final product.

In closing he emphasized the need for greater research in fundamentals relating to vibration of various types of concrete to show the way to better methods and better products.

The session closed with John Banker, Portland Cement Assn., Chicago, Ill., describing briefly "Vibration Practices in Structural Work."

Ultimate strength design theories discussed

The design session, under the chairmanship of Charles S. Whitney, Wednesday morning, Feb. 18, and held concurrently with the session on vibration of concrete, featured five papers on such subjects as limit analysis and design, stability of thin-shell structures, and static and dynamic behavior of beams.

Limit analysis and design

Many problems concerning limit analysis and limit design of reinforced concrete beams and frames can be treated geometrically in terms of the safe domain in load space, said Prof. William Prager, Brown University, Providence, R. I., in his paper, "Limit Analysis and Design."

The conventional analysis of indeterminate structures is restricted to the elastic range. Structures with ductile members may remain serviceable far beyond this range, so that the limits of their usefulness can not be explored by the methods of elastic analysis. Limit analysis is concerned with estimating the load intensity at which a given indeterminate structure ceases to be serviceable. Limit design, on the other hand, is concerned with allocating local yield strength to the members or cross sections of an indeterminate structure in such a manner that this structure remains serviceable under given conditions of loading.

Professor Prager then illustrated the procedure of treating a frame geometrically in terms of the safe domain in load space.

Design equations for ultimate strength

Several equations for use in limit design were proposed by Prof. Howard Simpson, Massachusetts Institute of Technology, Cambridge, in his paper "Design Equations for Ultimate Strength." He suggested equations for the ultimate capacity of rectangular beams, including a new "balanced design" equation which corresponds to a steel ratio considerably lower than that proposed by others. These equations, said Professor Simpson, include allowances for material variability and for a greater factor of safety against primary compression failure than against primary tension failure.

"It is possible," he said, "by combining features of both the working stress and ultimate design methods to arrive at better designs than those obtained by either method alone. More investigation must be completed, however, before a completely consistent and logical design procedure based wholly on the ultimate capacity concept can be devised."

Thin-shell structures

Prof. George C. Ernst, University of Nebraska, Lincoln, in "Stability of Thin-Shell Structures," presented test results confirming the validity of various theories for determining the failing load for structural members subjected to compression. The two most widely accepted and used methods, namely the empirical and tangent-modulus methods, were presented with specific adaptation to thin-shell reinforced concrete construction. Data from a series of tests were presented to illustrate thin-shell stability characteristics as well as to confirm the use of either of the two methods. (See Dec. 1952 JOURNAL, p. 277, for complete report.)

Yield-line theory

Another intriguing theory for limit design was advanced by Prof. Eivind Hognestad, University of Illinois, Urbana, in the paper "Yield-Line Theory for the Ultimate Strength of Reinforced Concrete Slabs." Developed primarily by Prof. K. W. Johansen, Danish Institute of Technology, Copenhagen, the yield-line theory is a plastic theory for the prediction of ultimate flexural strength of reinforced concrete slabs. It is based on plastic behavior occurring in a pattern of yield lines, the location of which depends on loading and boundary conditions.

The theory assumes that if a slab is overloaded, yielding will begin in regions of high moments, and as loading continues, yield lines will form and spread into a pattern. The load-carrying capacity of the slab will be exhausted when the yield lines have spread to the slab edges. Using this method, Professor Hognestad reported, the ultimate flexural strength may be evaluated, even for complex slabs, with limited mathematical effort. (See Mar. 1953 JOURNAL, p. 637.)

Blast loads

The advent of the atomic bomb and the possibility of its use, resulting in widespread destruction to buildings, has stimulated much research during the past five years on the reaction of buildings to blast loads. The investigation reported by Prof. Robert J. Hansen, Massachusetts Institute of Technology, Cambridge, and Joseph Penzien, Consolidated Vultee Aircraft Corp., Fort Worth, Texas, "Static and Dynamic Behavior of Reinforced Concrete Beams," was concerned with the elastic behavior of simple structural elements under suddenly applied loads of relatively short duration, that is, less than a second. Professor Hansen noted that there are many facets to the problem of behavior of buildings under blast loads. These include prediction of loading functions of the blast wave, analysis of dynamic response of structures to the blast load, and as a part of this problem, the properties of materials under the rather rapid rate of straining which the major structural elements of a building would undergo during the time the building is reacting to the blast wave.

Results reported by Professor Hansen indicate that strains in concrete and steel may be predicted with reasonable accuracy for both static and dynamic conditions of loading, provided that (a) proper allowance is made for the effects of plastic flow and cracking of the concrete, and (b) that an exact dynamic theory be used with an allowance for damping for the dynamic condition of loading. Both of the factors of dynamic magnification of strain and ability of reinforcing steel to withstand strain somewhat above the static yield point should be considered, said Professor Hansen, in estimating the yield point load of reinforced concrete elements designed to resist an impulsive load.

A further design consideration for dynamic loads, he said, is that it would seem advisable to under-reinforce reinforced concrete elements for two reasons. First, the increase in strength of concrete under dynamic conditions is more unpredictable than for steel; and secondly, if the ultimate strength of the concrete should be exceeded, complete failure may result, whereas if the dynamic yield stress in the reinforcing should be temporarily exceeded, the structure will merely deform plastically.

Looking ahead to 1954

With the successful completion of the 1953 convention in Boston, ACI's Technical Activities Committee is already looking toward the 1954 meeting in Denver and planning the program.

All those who have in mind offering papers for presentation at the 50th annual meeting should write to Institute headquarters no later than July 1, furnishing a synopsis which should make clear the intended scope of the paper and indicate features that, in the opinion of the author, will justify its inclusion in the program. Contributors should be prepared to have first drafts of manuscripts in the hands of the Technical Activities Committee for appraisal and acceptance by Sept. 15, 1953, and final manuscripts by Jan. 1, 1954.

From the replies received and suggestions from other sources, TAC will select the papers to make up each convention session. Write Institute headquarters about that contribution *you* believe merits a place on the program.

Awards announced at annual luncheon

Representing Mayor John B. Hynes, George C. Hyland, Public Works Commissioner, welcomed ACI to Boston. President Goldbeck, on behalf of the Board of Direction, then conferred awards to members who had performed outstanding service in the field of concrete and ACI endeavors during the past year. Boyd G. Anderson, F. Thomas Collins, Franklin R. McMillan, Mario G. Salvadori, Charles H. Scholer, Gerald M. Smith, and Charles S. Whitney received ACI awards.

Alfred E. Lindau Award

Franklin R. McMillan, consulting engineer, Asheville, N. C., formerly manager of the Structural and Technical Bureau and director of research of the Portland Cement Assn., was the choice for the Alfred E. Lindau Award in recognition "for his many years of labor in the development of standards of practice for reinforced concrete design." The award was founded in 1947 by the Concrete Reinforcing Steel Institute in honor of the late Alfred E. Lindau, past president of the American Concrete Institute. It is given only for outstanding contributions to reinforced concrete design practice and is not mandatory each year.

Construction Practice Award

F. Thomas Collins, consulting engineer, San Gabriel, Calif., received the American Concrete Institute Construction Practice Award for his paper "Tilt-Up Construction in Western United States," which was published in the October, 1951, ACI JOURNAL. This award was established in 1944 by the Institute to recognize the man on the job for his resourcefulness in translating design into the completed structure.

Noteworthy Research

Charles H. Scholer and Gerald M. Smith, professor and head of Department of Applied Mechanics, and assistant professor of applied mechanics, respectively, Kansas State College, Manhattan, received the Wason Medal for "noteworthy research" reported in "Use of Chicago Fly Ash in Reducing Cement-Aggregate Reaction" in the February, 1952, ACI JOURNAL.

Most Meritorious Paper

Charles S. Whitney and Boyd G. Anderson, partner and chief designing engineer, respectively, Ammann and Whitney, New York, N. Y., and Milwaukee, Wis., and Mario G. Salvadori, consultant to Ammann and Whitney and professor of civil engineering, Columbia University, New York City, were recipients of the Wason Medal for the "most meritorious paper" of the volume year, "Comprehensive Numerical Method for the Analysis of Earthquake Resistant Structures," which appeared in the September, 1951, ACI JOURNAL.

The Wason awards, established in 1917 by the late Leonard C. Wason, ACI past president, consist of a bronze medal and certificate to each awardee.

Two awardees at the Boston convention: Charles H. Scholer, left, who with Gerald M. Smith received the Wason Medal for "noteworthy research," and F. Thomas Collins, recipient of the ACI Construction Practice Award

Photo courtesy Pit and Quarry

Roderick B. Young elected to honorary membership

President Goldbeck announced at the noon luncheon the election to ACI honorary membership of Roderick B. Young, assistant director of research, Hydro-Electric Power Commission of Ontario, Toronto, Canada.

"An independent thinker equipped with keen powers of observation, backed by a logical and skeptical mind, his contributions to the concrete industry have been many," said President Goldbeck in making the award. "Many of the results of his continuing studies have been passed along in outstanding papers before the American Concrete Institute."

"The Institute, in conferring honorary membership on Roderick B. Young, is but reciprocating the honor and distinction which his faithful and continuous service, extending over some 36 years, has been bestowing on the Institute," said President Goldbeck.

Mr. Young is a past president of the Institute, served on its Board of Direction, and has been active on numerous technical and administrative committees. Author of many numerous papers on concrete, he received the ACI Wason Medal for "the most meritorious paper" for his 1937 paper "Concrete—Its Maintenance and Repair," and was awarded the Thomas F. Rowland prize of the American Society of Civil Engineers for 1928.

Roderick B. Young accepts certificate of honorary membership from President Goldbeck

Mr. Young has been actively interested in studies of the durability of concrete in service, as well as other fields including concrete control and inspection, winter concreting, construction, and maintenance and repair methods.

In 1950 he was appointed chairman of the Committee on Concrete and Reinforced Concrete of the Canadian Standards Assn. He was also one of the original organizers of the National Ready Mixed Concrete Assn. and is now an honorary member of that organization. He has also participated in activities of the Engineering Institute of Canada, the Assn. of Professional Engineers of Ontario, and the American Society for Testing Materials.

Though born in Minneapolis, Minn., Mr. Young has spent most of his active years in Canada. Since his graduation from the University of Toronto in 1913 he has been with the Hydro-Electric Power Commission of Ontario in various capacities.

Certificates presented

Retiring members of the Board of Direction were then given certificates in recognition of their services. Recipients were A. E. Cummings, director of research, Raymond Concrete Pile Co., New York City; Herbert J. Gilkey, professor and head, Department of Theoretical and Applied Mechanics, Iowa State College, Ames; Ivan L. Tyler, manager of research, Portland Cement Assn., Chicago, Ill.; and Charles E. Wuerpel, technical director, Marquette Cement Mfg. Co., Chicago, Ill.

Henry L. Kennedy heads American Concrete Institute

Henry L. Kennedy, manager, Cement Division, Dewey and Almy Chemical Co., Cambridge, Mass., was elected president of the Institute for 1953 when results of member balloting were announced at the Awards Luncheon on Wednesday.

A consulting engineer for 17 years, Mr. Kennedy specialized in reinforced concrete design and construction, with experience in concrete practice on the East and West Coasts and in the Middle West as well as in Canada, Germany, England, and South America.

Mr. Kennedy was for ten years head of the construction course of Wentworth Institute, Boston. His basic engineering education was obtained at Wentworth and Northeastern University with graduate work at Beaune University in France.

In 1947 Mr. Kennedy headed a new course in cement and concrete technology for the Harvard Graduate School of Engineering and selected the outside speakers to participate in the nine-week course. In conjunction with his work on this project, Mr. Kennedy was appointed to the Harvard faculty as a lecturer in concrete technology.

A member of ACI since 1934, Mr. Kennedy serves on its Committee 115, Research, and Committee 613, Recommended Practice for Proportioning Concrete Mixes. Administratively, he has been a member of the Institute Board of Direction since 1944 and was chairman of its Advertising Committee.

Mr. Kennedy's papers include "Concrete Containing Air-Entraining Agents," "Homogeneity of Air-Entraining Concrete," and "Revised Application of Fineness Modulus in Concrete Proportioning," in the ACI JOURNAL; "Entrained Air—Its Effects on Constituents of Portland Cement Concrete," ASTM *Proceedings*. His "Recent Developments in Concrete Durability," published in the *Journal of the Boston Society of Civil Engineers*, won that society's 1947 Herschel Award.

In addition to ACI, Mr. Kennedy is a member of ASCE, ASTM, AIA, and the Boston Society of Civil Engineers.

Other officers

Other officers announced were Charles S. Whitney, consulting engineer, Ammann and Whitney, New York, N. Y., and Milwaukee, Wis., for a two-year term as vice-president.

Elected to three-year terms as directors were Federico Barona de la O, head of Technical Department of Materials, Hydraulic Resources Ministry, Mexico City, Mexico; Arthur P. Clark, research associate, American Iron and Steel Institute, at the National Bureau of Standards, Washington, D. C.; Jay E. Jellick, manager, Portland Cement Information Bureau, San Francisco, Calif.; and Vernon P. Jensen, staff consultant, C. F. Braun and Co., Alhambra, Calif.

C. H. Scholer, head, Department of Applied Mechanics, Kansas State College, Manhattan, elected for a two-year term as vice-president in 1952, continues in that office.

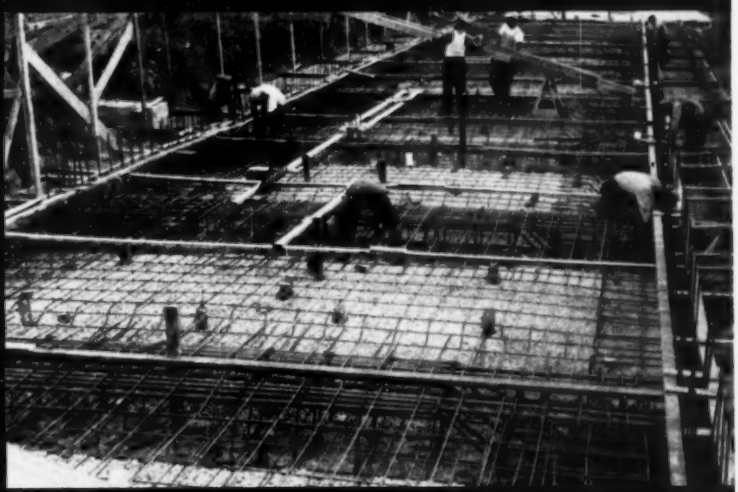
The five members elected to the nominating committee were Stanton Walker, engineering director, National Sand and Gravel Assn. and National Ready Mixed Concrete Assn., Washington, D. C.; H. F. Gonnerman, consulting engineer and formerly assistant to the vice-president for research and development, Portland Cement Assn., Chicago, Ill.; Roderick B. Young, assistant director of research, Hydro-Electric Power Commission of Ontario, Toronto, Canada; L. E. Grinter, dean of the Graduate School, University of Florida, Gainesville, Fla.; and R. E. Copeland, director of engineering, National Concrete Masonry Association, Chicago, Ill. The remaining three members of the nominating committee are past presidents Frank H. Jackson, Harry F. Thomson, and A. T. Goldbeck.

Henry L. Kennedy accepts the ACI presidency and envisages continued growth of the Institute

Rakennusinsinoori

This Finnish technical periodical is now being received regularly at Institute headquarters. A volunteer reviewer is needed to keep Members informed of pertinent papers in this publication through the "Current Reviews" section of the JOURNAL. Those interested please write the Secretary.

BETTER STRUCTURES



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President Goldbeck reviews ACI's services

The luncheon closed with retiring President Goldbeck discussing the history of the Institute and the wide range of ACI activities. Since its conception, he said, "the American Concrete Institute has been functioning through peace and war, and through periods of financial depression and prosperity, but ever on the alert to bring to its members information on developments in concrete which might help them in its successful and economical use."

In discussing the published *Proceedings* of the Institute, he said "Can there be anyone who cannot see the immense benefit which must have been reaped through this voluntary disclosure of information published by ACI for all to read and study? That process has been going on in the Institute and its predecessor, the National Assn. of Cement Users, for almost half a century during which time there have been some 3000 papers published in its many volumes of annual *Proceedings*." He then reviewed briefly the wide range of subjects covered by the papers published in the *Proceedings* and the JOURNAL, ACI Standards, and special publications; the great amount of voluntary effort which has made them possible was emphasized. (The complete address is contained in this month's JOURNAL, p. 697.)

Retiring President Goldbeck reviews ACI services and activities in his address at the Awards Luncheon

Precast concrete panels cast in plastic molds

Modern plastics, which have been used in everything from raincoats to automobile bodies, have now been put to a new use—as molds for thin-shell precast concrete panels. The use of plastic molds in casting thin-shell high ribbed roof and floor panels was described by John J. Hogan, Portland Cement Assn., New York City, in presenting the paper "Thin-Shell Rib Panels Site Fabricated in Plastic Molds," by M. R. Montgomery, Trepte Construction Co., San Diego, Calif., and LCdr. T. G. Atkinson, CEC, USN, Miramar, Calif. The session on thin-shell precast concrete, under the chairmanship of A. Amirikian, was held concurrently with a general session on Wednesday afternoon, Feb. 18.

After experimenting with various types of molds—wood, metal, plaster, and concrete—molds made of glass fabric and plastic were chosen as meeting the requirements of durability, light weight, and ease of repair.

The basic unit of plastic pan was approximately 4 x 4 ft. Two ounces of Fiberglas mat and one layer of Fiberglas cloth per square foot were used in these molds. The center of the form was reinforced for attachment of a special hydraulic release mechanism, used in separating the molds from the concrete panels. Besides light weight and durability, another advantage of the plastic molds was their elasticity, which aided in stripping the forms from the concrete casting.

The authors closed by saying that there are savings possible in precast work, in view of the constantly increasing cost of labor and materials, adequate to justify the cost of a thorough study of standardization and precasting techniques. The original design is where economy of precasting is determined, they said. Modules should be uniform throughout a geographic area, just as they are for concrete block and concrete pipe, before real economy can be accomplished. The authors also noted that real economy can be realized, not only with standard size and shape of modules, but also with standardization of all inserts and other appurtenances.

Factory production of precast elements

C. D. Wailes, Jr., C. D. Wailes Corp., Los Angeles, Calif., described "Factory

Production and Handling Problems of Thin-Shell Rib Panels." Precast panels, aggregating 350,000 sq ft were factory produced, trucked 117 miles to the job site, and erected to form the walls, floors and roofs of various types of buildings. An average weight of about 38 lb per sq ft for the 24-ft span panels was a factor in making transportation and production at a commercial plant economical.

If within reasonable trucking distance, factory production of panels of transportable size has both structural and economic advantages, said Mr. Wailes, particularly since factory precasting of panels results in less job complication and assures better quality products.

Four million square feet

A detailed description of the plant and job planning for producing large numbers of identical precast concrete roof elements was given by Charles C. Zollman, Vacuum Concrete Corp., Philadelphia, Pa., in the paper "Four Million Square Feet of Thin-Shell Rib Panels for Roof Framing." The panels were used for roof framing in 17 warehouses, each 200 x 1000 ft. The initial contract required the production of 140 panels per day, with a later additional contract calling for 132 panels per day. Considerations governing the choice of materials for molds were that they had to withstand 200 re-uses, be leakproof and sufficiently rigid to withstand deformations, accurate in dimensions to insure perfect alignment, cause no warping of cast panels, and require little maintenance. Concrete met these requirements, said Mr. Zollman, and by use of master and intermediate molds, the necessary working molds were produced at a cost of slightly less than 2 cents per sq ft of finished roof area.

Mr. Zollman believed that the casting and storage yards were the largest job-site installations built to date in the United States. (The yard installation in production since 1947 at Guam Island is believed to be the largest casting yard built.) So effective was the prior planning and the setting up and operation of the casting yards that the only important interruption to production was when the construction of cast-in-place rigid frames could not keep up with the supply of panels.

Some of the reasons which enabled the general contractors, inexperienced in thin-shell construction, to perform such a remarkable job at extremely low cost were listed by Mr. Zollman as (a) the designer's awareness that for a structural element to be sound and economical engineering-wise, the designer has to understand thoroughly the builder's problems; (b) close cooperation between the engineers, owners and contractors, and (c) the fact that the general contractor is in full control of each and every phase of the work, and can exercise his ingenuity to develop innumerable "slick" devices to aid in manufacture and erection.

Precast barracks

"Fabrication and Erection of Precast Enclosure Framing for One-Story Barracks," by Ford J. Twaits and Martin M. Denn, Twaits–Morrison–Knudsen–Macco, Los Angeles, Calif., was presented by Lt. T. H. Gut, Bureau of Yards and Docks, Department of the Navy, Washington, D. C., in the absence of the authors.

In constructing the barracks, the thin-shell ribbed roof panels were manufactured in a central casting yard and the wall panels cast on the building floor. When completed, 117 prefabricated concrete buildings will have incorporated 5756 precast roof panels, totalling 1,150,000 sq ft of surface area, and 3268 precast wall panels totalling 724,200 sq ft of surface area. Considerable repetition in the various buildings enabled the contractor to employ production line methods for producing the component parts.

The authors described a unique piece of equipment for stripping the panels from the molds; a converted lumber carrier with 15-ft clearance between the wheels and a minimum vertical clearance of 7 ft was rigged with vacuum and electrical hoisting equipment. After the steam-curing cover had been removed and the side forms hinged back, the carrier was driven into position over the mold, the mat dropped, electric hoist started, and the roof panel was raised from the mold, then transported to the stockpile. With this equipment, stripping the panels from the molds was reduced to a completely mechanical operation.

Ammunition storage buildings

Benton H. Prock, Prock Construction Co., Camden, Ark., in "Precast Concrete Buildings for Ammunition Storage," reviewed the factors involved in mass production of precast panels.

Prefabricated building costs are determined largely by the size of the project; the larger the project, the lower the unit cost. Planning, he said, is perhaps the most important phase of the whole operation. This must include casting yard layout, sequence of casting operations in a yard, mold and side form materials and methods of holding these forms, size and capability of lifting equipment, provisions for accurately locating inserts, and holding to specified dimensions.

Erection of the completed precast members must be kept constantly in mind, he said, since their size and shape affects the required hauling and lifting equipment, the connections, and the techniques and sequence of assembly into the finished structure.

Concrete forms effective radiation shield

"The advent of the nuclear energy industry presents considerable demands on the concrete technologist," said Edwin J. Callan, Concrete Research Division, Waterways Experiment Station, Jackson, Miss., in his paper "Concrete for Radiation Shielding." The general session Wednesday afternoon, Feb. 18, under the chairmanship of Henry L. Kennedy, was held concurrently with the one on precast concrete.

Large scale production of penetrating radiation and radioactive materials, as a result of the use of nuclear reactors, particle accelerators, industrial radiography, and X- and gamma-ray therapy entails the use of shielding materials for the protection of operating personnel against the biological hazards of such radiation. The primary factor involved in radiation shielding is the reduction of the intensity of the radiation to the desired level. Secondary to this are economic and mechanical factors.

Almost any material will serve for shielding purposes if sufficient thickness is used, Mr. Callan said. However, the use of materials requiring excessive thicknesses may be precluded on an economic basis; other materials requiring only moderate thicknesses may not be practical for economic or mechanical reasons. Thus, although water is a good neutron shield, it requires excessive thicknesses for shielding accompanying gamma radiation, and water tanks are relatively fragile. At the other extreme, lead shields are very effective against gamma radiation, but lack mechanical strength for large, permanent shielding structures.

Concrete, Mr. Callan reported, is an effective, versatile, and economic material for permanent shielding installations. It possesses good compromise thickness requirements for both neutron and gamma-ray attenuation, sufficient mechanical strength, low maintenance, and reasonable cost. While ordinary concrete in sufficient thickness will provide satisfactory shielding, he said, heavy concrete, made from special aggregates with a generally higher unit cost, is often preferable due to smaller thickness requirements. Heavy aggregates, such as limonite, magentite, barite, and even scrap iron, have been used successfully. Because of the reduction in shielding thickness, and attendant space saving, Mr. Callan considered that for large shields, heavy concrete was on a competitive basis with ordinary concrete, in spite of the difference in unit cost of the concrete alone. In general, he concluded, no major changes in concreting practice are required for radiation shielding.

Other papers on the afternoon program covered use of fly ash in concrete, "accidental" air in concrete, freezing and thawing tests on concrete, and shotcreting.

Accidental air

"Accidental Air in Concrete," by M. F. Macnaughton and J. B. Herbich, Milton Hersey Co., Ltd., Montreal, Quebec, and Aluminum Co. of Canada, Chute du Diable, Quebec, respectively, dealt with the unusual problem of making concrete with sand that possessed the property of accidentally entraining air.

Mr. Macnaughton described a number of cases arising in recent years in the Laurentian Shield area of Canada, and described the measures adopted on one project to control vagrant and final air content in the concrete mixtures within reasonable and normally acceptable limits.

A satisfactory degree of control of air content and consistency when producing concrete with this type of sand was achieved

by adding a surplus of an air-entraining agent to the mix and then eliminating the more unstable faction, due to the organic materials in the sand, by the addition of a foam control agent in sufficient amount to leave the desired quantity of residual air in the concrete. Mr. Macnaughton noted that with sand possessing these characteristics, it is also necessary to set maximum as well as minimum limits for length of mixing time.

Chicago fly ash

Test results on "Strength and Durability of Concrete Containing Chicago Fly Ash" were reported by George W. Washa and Norman H. Withey, University of Wisconsin, Madison, and consulting engineer, Madison, Wis., respectively. Professor Washa reported that generally the amount of fly ash added must be somewhat greater than the amount of cement removed, if the strengths of concrete made with and without Chicago fly ash at 28 days are to be equal. However, he reported, at the age of one year, concrete containing 20 percent fly ash (by weight of total cementing materials) had a greater compressive and flexural strength than concrete made without fly ash.

Results of a group of freezing and thawing tests showed that air-entrained concrete made with and without Chicago fly ash is equally frost resistant. Fly ash in concrete made with Type I portland cement increased resistance to attack by sulfuric acids.

The tests were confined to fly ash from one electric utility company in Chicago, and are not necessarily applicable to fly ashes from other sources, said Professor Washa. (See p. 701 in this month's JOURNAL for the complete report.)

Freezing and thawing of concrete

Thomas B. Kennedy and Katharine Mather, Concrete Research Division, Waterways Experiment Station, Jackson, Miss., reported on the "Correlation Between Laboratory Freezing and Thawing and Weathering at Treat Island, Maine." Six coarse and eight fine aggregates were used in 48 combinations to make concrete specimens all with the same water-cement ratio, air content, and slump for comparative testing in accelerated freezing and thawing and exposure to natural weathering at mean-tide elevation at Treat Island, Me.

Comparing results obtained in the laboratory with those in the field, said Mr. Kennedy, indicates that each aggregate combination behaves in an individual manner in each exposure. Prediction of behavior in one type of exposure from behavior in another cannot be made, he said, unless all the differences between the two can be fully evaluated. Otherwise, correlation can only be established empirically.

Thin-shell concrete dome

The development of a simple, quick method for designing domes and its application to the new dome built last summer on the Hayden Planetarium at the Boston Museum of Science was expounded by John H. Hession, National Gunite Corp., Boston, Mass., in the paper, "Guniting the Hayden Planetarium Dome."

The dome, first of its type to be constructed in Boston, is self-supporting. The ratio of the thickness of the dome's 2½-in. Gunite shell to the 65-ft diameter is only one-third that of an egg-shell which averages 1/64 in. thickness and 1¾-in. diameter.

Pneumatic placement of concrete causes high compression and density, thus making shotcrete much stronger for a given cement content than conventional cast-in-place concrete and permitting thinner sections, said Mr. Hession. The 2½-in. thick self-supporting reinforced concrete shell was Gunited in horizontal zones 5 or 6 ft along the meridian to full thickness, the laps between zones tapering on a 30-in. slope so as to secure a substantially long bonding surface. In this way, he stated, a lap can be made anywhere between the old and new Gunite as the bond strength will be greater than either the shear or the bending strength.

Research projects previewed

Previews of future developments in concrete were presented at the annual open session of ACI Committee 115, Research, Thursday morning, Feb. 19. Douglas E. Parsons, chief, Building Technology Division, National Bureau of Standards, Washington, D. C., served as session chairman in the absence of S. J. Chamberlin, chairman of Committee 115. The program included papers on evaluation of waterproofers for concrete, prestressed concrete for highway bridges, load distribution in short-span highway bridges, shrinkage and plastic

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flow of concrete under constant stress, characteristics of cement grout, post-stressed floor beams of lightweight masonry units with glass cable as the tensioning member, strength of T-beams, and effect of gap grading.

The information presented at the annual research session is not released for publication; however, the authors and organizations concerned have released the following brief synopses of the preliminary results reported at the meeting.

Creep of concrete

Determination of creep of concrete under constant stress was discussed by Prof. Howard Simpson and James E. Roberts, Massachusetts Institute of Technology, Cambridge. To study the creep characteristics of certain manufactured concrete products, a constant load apparatus utilizing a hydraulic pressure system and a nitrogen gas follow-up system was designed and constructed, and is now in the process of being tested and improved. Preliminary tests have been made, comparing the creep behavior of various concrete cylinders.

Silicone waterproofers

Evaluation of silicone waterproofers on concrete was the topic covered by F. O. Anderegg, materials technologist, Somerville, N. J. A series of about 25 colorless waterproofers, mostly silicones, were applied to bricks made of Waylite aggregate having a very open texture and to bricks made from 1:2:4 concrete. In addition, two silicones were applied to specimens made from 1:1:6 cement-lime sand mortar, corresponding to masonry mortar joints. The absorption of specimens in ¼-in. of water for 24 hr has been determined, as well as the breathing rates. Part of the specimens have been in contact with a sodium sulfate solution and part have been exposed to natural weathering. Further observations will include the results of over-winter exposure in the presence of and in the absence of sodium sulfate and periodic determinations of absorptions to secure better knowledge of probable effective life.

Gap grading

Gap grading of concrete aggregate was discussed by Walter Price, Bureau of Reclamation, Denver, Colo. The use of gap (discontinuous) grading in concrete aggregates is a development of European engineers. European practice indicates certain advantages and difficulties which may be encountered. Laboratory experiences in mixing, placing, and testing gap graded concrete were discussed. Test results indicate possible practical uses on large dam construction.

Cement grouts

Characteristics of cement grouts were reported by T. G. Clendenning, Hydro-Electric Power Commission of Ontario, Toronto, Canada. Consideration was given to some requirements of grouts for various applications including foundations, grouted aggregate concrete, contraction joints, tunnel linings, and road-bed stabilization, and to the effects of constituents on behavior. Preliminary results were given to indicate the influence on sedimentation of consistency, admixtures, and fillers.

Prestressed concrete beams

Ultimate strength of prestressed concrete beams was the topic of J. H. Appleton, University of Illinois, Urbana. Since July, 1951, the University of Illinois has been engaged in a research program on prestressed concrete for highway bridges. The object of the investigation is to investigate the flexural and shearing strength of prestressed concrete members. Preliminary results of tests on 65 beams show a good correlation between computed and measured flexural strengths. The tests indicate also that the tensioning stress and the ratio p/f_c' are important variables affecting the shearing strength of prestressed concrete beams.

Glass prestressing cables

A floor beam of lightweight masonry units post-stressed with glass cables was discussed by Ray B. Crepps, Owens-Corning Fiberglas Corp., Newark, Ohio. A lightweight floor beam 16 in. wide x 8 in. deep x 18 ft 8 in. long was constructed from 8-in. three-cell Haydite masonry units. Interspersed at the middle and quarter points were solid spacer block 4 x 8 x 16 in., each having cut-out spaces through which the tensioning cables were positioned 1⅝ in. below the middle. The tensioning element consisted of six cables formed by winding glass cords continuously around the cylindrical and tension

holders, spaced approximately 18 ft apart. The assembly was then twisted so that the combined strand [illegible]ed a cable. The post-stressing [illegible]omplished by (a) threading the ca[illegible]rough the openings in the space block, (b) placing the metal holders through the holes provided in the 1-in. thick end plates, and (c) tightening by the use of a previously calibrated torque wrench. Deflection observations have been made over several months while the beam was loaded to 100 lb per sq ft.

Strength of T-beams

Strength of T-beams under combined shear and torsion loading was covered by Earl I. Brown, II, University of Texas, Austin. Ordinary elastic calculations, including torsion, on typical spandrel beams, indicate excessively high shear stresses. Since there are few, if any, failures attributed to these stresses, investigation seemed desirable. In this study, shear and torsion is obtained on small scale symmetrical and unsymmetrical T-beams by a concentrated load applied eccentrically. Eccentricity is varied to obtain varying shear-torsion ratios. With each test, a concentrically loaded companion beam is tested. Test strengths have been much higher than elastic analysis would predict, but are more nearly in line with calculated values when torsional resistance is based upon plastic methods. The study is still in progress.

Short-span highway bridges

A model study of load distribution in short-span highway bridges with steel stringers and concrete pavement was reviewed by Dean Frank Kerekes, Iowa State College, Ames. The study reviews field tests that were made on two bridges of the type described in the title. The discussion of the models involved the technique employed in the design, construction, and instrumentation of the models. A brief outline was given of the objectives of the study.

Panel discussion of concrete problems

The panel session, Thursday afternoon, Feb. 19, with Stanton Walker, engineering director, National Sand and Gravel Assn. and National Ready Mixed Concrete Assn., Washington, D. C., as moderator, was as usual one of the main attractions at the convention. A wide variety of questions were asked and answered, and everyone felt that they had received answers to at least one or two questions that had been bothering them for some time.

The panel was composed of Miles N. Clair, president, The Thompson and Lichtner Co., Inc., Brookline, Mass.; M. H. Cutler, assistant chief structural engineer, Stone and Webster Engineering Co., Boston, Mass.; Myle J. Holley, Jr., associate professor of structural engineering, Massachusetts Institute of Technology, Cambridge; Frank H. Jackson, principal engineer of tests, Bureau of Public Roads, Washington, D. C.; Frank Kerekes, assistant dean of engineering, Iowa State College, Ames; E. B. Oberly, construction superintendent, Portland Cement Assn., New York, N. Y.; Walter H. Price, chief, engineering laboratories, Bureau of Reclamation, Denver, Colo.; C. H. Scholer, professor of applied mechanics, Kansas State College, Manhattan; M. A. Swayze, director of research, Lone Star Cement Corp., New York, N. Y.; and George W. Washa, professor of mechanics, University of Wisconsin, Madison.

What are the difficulties involved in adapting prestressed concrete to continuous structures, either monolithic or precast?

If a prestressed concrete member is an element in a continuous beam or frame, the number of loading conditions to be considered by the designer will, of course, increase. That is, said Professor Holley, he must recognize that the member can be stressed by loads elsewhere in the structure.

In some cases it may be desirable to perform the prestressing operation on the separate (precast) members and then to join them in a manner to produce the desired continuity. Alternatively one might cast the entire (monolithic) structure prior to prestressing. In the latter case, he said, the stresses produced by prestressing will depend not only upon the properties of the member itself (cross section size and shape, magnitude and location of steel force, etc.) but also upon the restraint afforded by adjacent members. It is likewise apparent, noted Professor Holley, that the operation of pre-

stressing a particular member will cause stresses not only in that member but also in other members of the structure. Due to the foregoing he emphasized that the construction sequences (and particularly the prestressing sequences) may require much more detailed planning in the case of an indeterminate structure than in the case of a determinate structure.

Finally, he added, we have considerable data on the action of statically-determinate prestressed members for loads up to failure. Relatively little data is yet available for the corresponding action of statically-indeterminate prestressed members.

None of the foregoing statements imply inherent impracticality of prestressed concrete for prestressed continuous structures, said Professor Holley. Rather they represent reasons why, at this time, there is more incentive to exploit statically determinate applications.

If the interest in linear prestressed concrete continues and it proves to be economical, he said, there is no doubt that prestressed continuous structures will be built in the United States. European engineers have already successfully applied prestressing to indeterminate structures, including both bridges and buildings.

What details are important in casting concrete slabs on the ground for basementless houses?

Mr. Oberly recommended that the best surface would be obtained by using steel forms along the edges. As for the base course underneath the slab, he said, that depended on the subbase. Generally, a granular gravel or similar material is used as a base material, especially if the slab is built on predominantly clay soil. He recommended a 4 to 6-in. base of bank gravel or some similar material.

Douglas E. Parsons, National Bureau of Standards, Washington, D. C., amplified these remarks by saying that it is generally agreed that concrete slabs on the ground need a good stable foundation, and just what is to be done on the job site to secure that depends upon the nature of the soil. He then emphasized that in concrete slabs for buildings, the edge of the slabs should be thoroughly insulated against heat loss. It has been found, he said, that most of the heat lost in the slab in a structure the size of an ordinary dwelling, is lost at the edge.

"Corridor talk" held the attention of at least two different groups here. Left to right are T. C. Powers, Portland Cement Assn., Chicago; Roderick B. Young, Hydro-Electric Power Commission of Ontario, Toronto, Canada; John G. Dempsey, Sollitt Construction Co., Chicago; and L. Boyd Mercer, Ready Mixed Concrete, Ltd., Melbourne, Australia

There is, however, he pointed out, a difference of opinion between the authorities as to whether or not a vapor barrier underneath the slab is necessary, or even desirable. There are some who hold that the vapor barrier is essential because, during at least part of the time, the vapor pressure below the slab is greater than that above. On the other hand, there are those who feel that the vapor barrier is objectionable because there are times when the vapor pressure above the slab is greater than that below, and with the vapor barrier underneath the slab there is the possibility of condensation within the slab.

Prof. Walter C. Voss, Massachusetts Institute of Technology, Cambridge, reported the results of some tests conducted by Levitt Homes, Inc., on the use of a vapor barrier. On a number of houses recently completed, paper was used instead of a complete vapor barrier. The humidity inside the houses was 10 to 15 percent lower than those with the complete sealing of the slab. This seems to indicate, said Professor Voss, that a completely sealed vapor barrier is not necessary.

What causes cracking of shotcreted walls, usually along the lines of reinforcement?

Mr. Clair reported that investigations have shown that in such structures, the cracking seems to be due to the rebound sand that accumulates in back of the reinforcing

How can cracks due to thermal expansion of a building be eliminated or controlled?

Professor Voss illustrated what could happen when control joints are not used by describing a building that had a 600-ft wall without a joint. The wall had expanded 1¼ in. past its original position at both ends, had torn loose from the steel frame inside, and wrecked the glazed tile column encasement inside the building. He emphasized that this was no fault of the mortar or the wall unit, but the fault of the designer in building such a wall without expansion joints. He emphasized that it is necessary to control thermal expansion of long reaches of walls through the use of control joints that will take care of the expansion.

Mr. Oberly pointed out that it is imperative that contractors, engineers, and architects know and understand the necessity for control and expansion joints in concrete walls. Cracking can be almost completely eliminated, he said, by the use of such joints.

The discussion then centered on the use of expansion joints for precast concrete walls where the wall panels are in reasonably large sections, the joints between the panels grouted in, and in some cases the projecting steel is welded to the next panel. The question was then asked: "Are those joints sufficient to take care of the thermal expansion, or should they be specially treated so that the panel will always remain together and be structurally sound, as well as taking care of expansion?"

Mr. Cutler was of the opinion that any of the panel-wall construction should definitely take care of expansion and contraction at the joints, not necessarily at every joint, but through a series of control joints.

"There are many different ways to take care of expansion and contraction, but there are few standardized or recommended methods in terms of temperature changes," said Professor Kerekes. He then described the design of a 216 ft long stadium which was exposed to temperature changes from − 20 F to 115 F. The stadium was divided into three 72-ft units and provided with a copper seal between each of the three units; the walls were 18 ft wide and 45 ft high. There are recesses in the front and rear portions of the arch ribs which carry the stadium floor. The front and rear walls were cast after the arch rib forms were stripped. The arch rib span is 82 ft; there are no intermediate columns. The structure is now ten years old and no damage due to expansion is evident, he said.

Mr. Oberly noted that it is possible to place control joints further apart in such structures than it is in ordinary buildings. He recommended that in buildings that are cold on the outside and warm on the inside, expansion joints should not be placed more than 20 ft apart. He noted that the reason that so much trouble is experienced on foundation walls or walls from the footings up to the first floor window sills is that there are three different temperature changes: one below grade outside, one above grade, and one inside the wall.

Additional comments on control joints in the tilt-up or precast type of building were furnished by C. D. Wailes, Jr., C. D. Wailes Corp., Los Angeles, Calif. In building earthquake resistant structures, he said, it is customary to have rigid connections between walls and pillars which generally occur 20 to 25 ft apart. However, where the panels are thoroughly bonded, there is a definite problem of cracking in the panel. One solution which has reduced cracking in the panels has been the installation of a slip joint coated with paraffin oil, so that the panel can move slightly.

Is fine rust on reinforcing bars detrimental to bond?

"It is generally considered that if you have a fine powdery rust on the bar, bond is better than if you have a scaly type of rust, which is detrimental to the strength of bond between the steel and the concrete," answered Professor Kerekes.

What changes are necessary in the finishing procedures for air-entrained concrete as compared with regular concrete in finishing a concrete floor both by hand finishing and the power method?

For heavy duty floors, Mr. Oberly recommended that air-entraining cement not be used unless the finishing procedure is well adapted to its use. He advised that it would be all right to use air-entraining cement on a one piece floor, but suggested that where a floor is compacted with several layers of low slump concrete, that air-entraining cement would not be advisable.

He warned that the air content should be kept low; that the floor should not be overfinished. Too much air will make the concrete tacky and difficult to finish; if you overdo the floor; it will commence roughing, he said. All that is necessary, he said, is to screed the floor or to float it and finish it once with a steel trowel by turning the trowel a little more up on edge than ordinarily.

L. H. Tuthill, Bureau of Reclamation, Denver, Colo., noted that air entrainment speeds up concrete finishing operations since it inhibits bleeding, but otherwise the finishing procedure is similar to that without air entrainment.

In paving operations, Mr. Clair agreed that it was possible to finish it more quickly but warned against over-finishing.

Mr. Jackson noted that in paving construction there is a tendency among highway departments to increase the percentage of air in pavement concrete as a further protection against the use of salts used to melt ice as well as increasing durability in general.

Charles W. Allen, Ohio Highway Department, Columbus, reported that Ohio specifications are increasing the specified air content from 3–6 percent to 4–7 percent. They do not anticipate any difficulties since in the past, on isolated jobs, they have placed concrete with more than 7 percent air with no finishing problem.

What are the pros and cons of using 24,000 psi for intermediate grade steel for tensile reinforcement with the new A-305 bars?

Professor Kerekes reported that the matter of increasing the allowable unit stress in intermediate grade steel or any other grade is an active subject before the ACI Building Code Committee. "It isn't an easy matter to step up the allowable unit stress in the tensile steel. Although the increase might be satisfactory as far as the tension in the steel is concerned, there are too many related problems, among which shear and diagonal tension are involved, and we feel that the effects of the increase of the allowable unit stress in steel should be studied in connection with all of these other types of unit stresses."

Is there any tendency for a prestressed concrete beam to buckle during prestressing operations?

"If the prestressing force is large enough it may cause the concrete to crush. However, if lateral contact between the steel and the concrete is provided at a sufficient number of points, the prestressing force cannot make the member buckle," said Professor Holley. "This has been demonstrated both theoretically and by actual tests. A practical example is the large, thin-walled, prestressed tank. In this case the wire wrapping exerts a radially-inward load which may exceed the theoretical (hydrostatic) critical buckling load; yet the wall does not buckle."

Aside from Type V cements, why do we have these other special types of cements? In other words, why don't we have just Type I and Type V?

Mr. Price noted that possibly the reason for Type II cement is the same as for Type V; that is, there might be structures which would not require Type V cement, but to combat the sulfate action in the soil, Type II would be preferred to Type I. He said that Bureau of Reclamation specifications, when sulfate action is not a problem, permit Type I cement. Although the Bureau uses Type III cement seldom, he believed there were places where its high-early strength was advantageous. He noted that Type IV cement is being used less and less in the construction of dams.

"We need Type III cement to speed construction," said Mr. Swayze. "While it is a premium cement, nevertheless the contractor by the use of Type III cement, will so save by the fast re-use of forms that he can save the extra cost of the cement and get speedier construction."

In the controversy between Type I and Type II cement as to their durability, except under sulfate exposure, Mr. Swayze believed that the result of the Long-Time Study amply demonstrated that Type II cements do not show any advantage in durability over Type I.

Professor Voss acknowledged the necessity of Type V cement, but was of the opinion that the other four were "academic subdivisions of an engineer's pipe dream." He believed that by eliminating Type II and IV cement, and using only Type I, III, and V, manufacturers could produce better cement, standardize their processing, and not be forced to stockpile a lot of cement that is seldom used.

Northeast convention committee

The phrase "It's Boston in '53," slogan of the local convention committee, will long be remembered by those attending the 49th annual convention. Unlimited effort by the committee brought more than 800 ACI members and friends to the Boston meeting, 360 were from Massachusetts alone. Climax of all the committee activity was the excellent New England lobster dinner on Wednesday evening, with the local committee, the concrete and building industry, and engineers from the New England area serving as hosts to the ACI members and their wives.

The Boston convention committee, under the general chairmanship of Henry L. Kennedy, included Prof. Emil A. Gramstorff, Northeastern University, Boston, as treasurer, and Robert J. Gray, Dewey and Almy Chemical Co., Cambridge, as secretary. The executive committee was composed of the above three men, and Myron A. Howe, Boston Sand and Gravel Co., Cambridge, and F. E. Votaw, Portland Cement Assn., Boston.

Coordinating committees were composed as follows: John Allen, Corps of Engineers, Boston, government agencies; D. J. Cameron, Fireproof Products Co., Inc., Bronx, N. Y., reinforcing steel industries; Miles N. Clair, Thompson and Lichtner Co., Inc., Brookline, Mass., testing laboratories; Joseph Devaney, Parker-Danner Co., Hyde Park, Mass., construction equipment; Prof. Paul A. Dunkerley, Tufts College, Medford, Mass., colleges; Jack Freedman, Massachusetts Cement Block Co., Medford, concrete products; William L. Galvin, architect, Cambridge, Mass., architects; Prof. Albert Haertlein, Harvard University, Cambridge, colleges; Myron A. Howe, Boston Sand and Gravel Co., Cambridge, ready-mixed concrete industry; A. B. MacMillan, Aberthaw Co., Boston, building contractors; F. A. McAdam, Dewey and Almy Chemical Co., Cambridge, building specialties industries; Paul Norton, consulting engineer, Boston, structural engineers; William Nye, Turner Construction Co., Boston, building contractors; Maurice A. Reidy, consulting engineer, Boston, structural engineers; Prof. Howard Simpson, Massachusetts Institute of Technology, Cambridge, colleges; Prof. Ernest L. Spencer, Northeastern University, Boston, colleges; Prof. Walter C. Voss, Massachusetts Institute of Technology, Cambridge, colleges; and Roderick B. Young, Hydro-Electric Power Commission of Ontario, Toronto, Canada, Canadian societies.

Orchids to the ladies

A special ladies' program for women guests at the Boston convention made their visit a pleasant one, long to be remembered. A coffee hour was held each morning in a special lounge room reserved for the use of women guests during the convention, with various tours and activities scheduled for each day, following the coffee hour. All functions on the ladies' program, with the exception of meals, were with the compliments of the local committee.

Following an informal talk on Boston by Mrs. Rudolph Morris on Tuesday morning, the ladies had luncheon at Ye Old Union Oyster House, famous since 1826, and located in the famous Boston market area, which was then followed by a tour of Boston. The tour included such famous landmarks as Beacon Hill, Boston Common and Public Garden, State House, Kings Chapel, site of the Boston massacre, Faneuil Hall, Paul Revere House, Old North Church, Boston Navy Yard, U.S.S. Constitution, Bunker Hill Monument, and many other points of interest.

Following the annual Awards Luncheon on Wednesday, the ladies toured the Christian Science Publishing House and Mother Church. The former houses the famous Mapparium, and the latter is one of the largest and most impressive churches in the world. Wednesday evening, of course, was the big New England lobster dinner.

Thursday the ladies had lunch at the Window Shop in Cambridge, a place which recaptures some of the atmosphere and food of old Vienna. Following the luncheon was a concert and tour of the Isabella Stewart Gardner Museum. This building, one of the show places of Boston, is modelled after a

Venetian palace and is filled with art treasures and flower displays.

The committee for the ladies' program included Mrs. Howard Simpson, chairman, Mrs. Hugh S. Ferguson; Mrs. Emil A. Gramstorff; and Mrs. Henry L. Kennedy. The committee was assisted ably by a large group of hostesses on the various days, including Mrs. George Blackwood, Mrs. Paul A. Dunkerley, Mrs. William L. Galvin, Mrs. Robert Gray, Mrs. Albert Haertlein, Mrs. Myron A. Howe, Mrs. Langley Isom, Mrs. A. B. MacMillan, Mrs. Francis A. McAdam, Mrs. Paul Norton, Mrs. Maurice A. Reidy, Mrs. Mason Rogers, Mrs. Ernest L. Spencer, Mrs. William Taggart, Mrs. Walter C. Voss, and Mrs. Rachel Westergaard.

New vibration techniques being tested on western project

While many interesting techniques were initiated on the Duchesne tunnel project in the western United States, the method of vibration is of particular interest. This tunnel is a six mile bore, of horseshoe shape, with a finished diameter of 9 ft 3 in. Contractors recently completed continuous placement of concrete in the tunnel arch. Concrete, which was mixed in the tunnel, was placed pneumatically using the standard advancing slope method.

Viber electrical internal vibrators with 2⅛-in. head were used through the spring line doors to consolidate and vibrate the

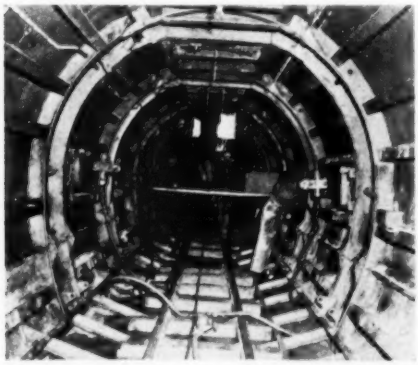


Fig. 1—General view of vibrator arrangement with two air external vibrators on the form ribs and two internal electric vibrators used through the inspection windows in the forms

concrete immediately above the invert construction joint. These vibrators were used on the advancing slope concrete until it reached, in elevation, the bottom of the door opening. The doors were then closed and Viber external vibrators used (Fig. 1).

The external vibrators were fastened to the form ribs with an air clamp slightly above the spring elevation (Fig. 2). They were moved forward in 8-ft increments and were usually kept well below the concrete flow line. As this was a free flow tunnel without the requirements for arch grouting, and because of the effectiveness of the external vibrators, no special vibration in the very top of the form was considered necessary. The vibrations seemed to travel throughout the length of the slope (20 to 25 ft) except perhaps near the tee next to the invert construction joint.

External vibrators, mounted one on each side, were operated while the concrete was being discharged. This occurred every two or three minutes and lasted for about 30 to 40 sec. If the amount of overbreak was small, and with the section tight for normal thickness of concrete (11 in.), the vibrators were operated for slightly longer periods.

The contractor used a third external vibrator mounted on the 8-in. discharge line near the upper elbow. This was a help in preventing "line plugging."

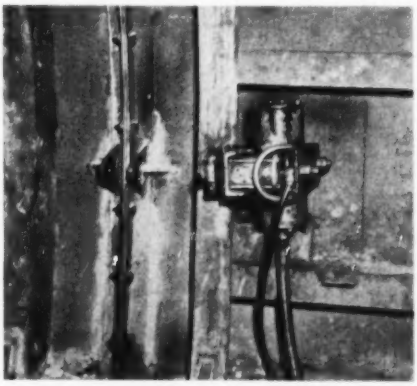
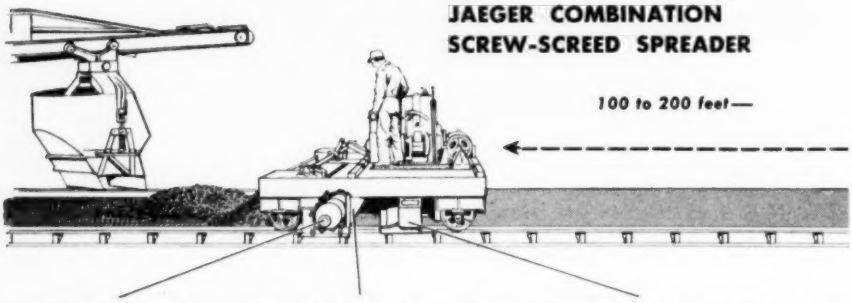


Fig. 2—Air external vibrator equipped with an air ram clamp shown in operating position on the form rib. The vibrators were moved to successive form ribs as concrete placing progressed

JAEGER 3-SCREED PAVING TEAM

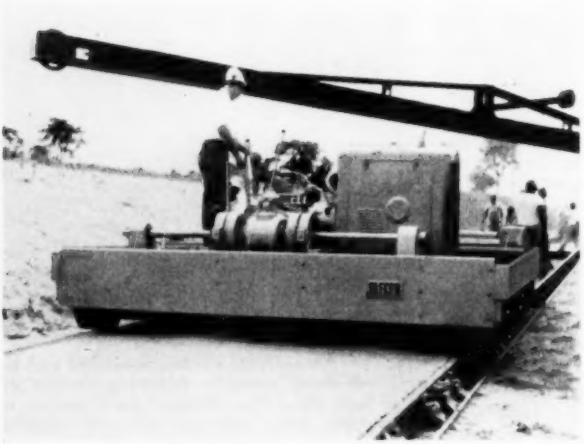


Spreading Screw: Remixes, compacts and spreads material evenly, form to form, without shovelers.

Strikeoff Plate: Makes initial strikeoff to approximate grade line (other spreaders do no more than this).

#1 Screed (Metering): Makes precision strikeoff with 12" oscillating shoe. Corrects any excess or deficiency left by strikeoff plate. Saves cost of shovelers for carryback and far costlier backtracking of the paver.

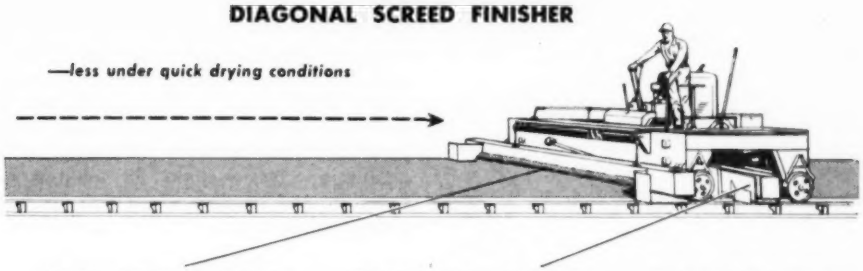
These two machines fully mechanize the laying of highest quality, precision-finished concrete slab. They assure big savings in labor ahead of and behind spreader and finisher—handle full output of largest dual drum pavers—eliminate the costly delays of paver backtracking.



No other spreader does so much or leaves such an ideal condition for the finisher. That's because no other spreader remixes concrete on the subgrade as does this Jaeger, nor offers an oscillating metering screed. The result can be seen in this photo taken at rear of the spreader. Widths —10'-15' and 20'-25'.

A two-machine combination that speeds paving, cuts labor costs, and can eliminate a second finisher!

JAEGER TYPE "X" DIAGONAL SCREED FINISHER



#2 Screed (Transverse): Works with just the right roll of material, as "metered" by the spreader. No piles to buck, no high or low spots—uniform compaction assured.

#3 Screed (Diagonal): Pivots to any angle needed to carry material uphill on pitched slab or superelevated curves. Compacts material solidly against higher form. Corrects any irregularities left by transverse screed because it meets material at a different point and at an angle—finishes stiffest mixtures without tearing.

Not only does this Jaeger team speed production and save labor costs. It can also eliminate the need for a second finisher behind the spreader on high production work. (Has already done so in several states.)

Evidence of the Screw-Screed Spreader's metering action—a just right roll of material ahead of the first of the finisher's screeds. It means steady forward progress—no costly delays. It means uniform density and precision finish—a longer lasting, better riding slab. Finisher widths—10'-15' and 20'-25'.

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Who's Who This Month

A. T. Goldbeck

Retiring ACI President A. T. Goldbeck's address at the general luncheon of the 49th annual convention in Boston, "The Services of the American Concrete Institute," appears on p. 697.

A. T. Goldbeck, engineering director, National Crushed Stone Assn., Washington, D. C., is so well known to ACI members that little introduction is necessary.

G. W. Washa and N. H. Withey

"Strength and Durability of Concrete Containing Chicago Fly Ash," p. 701, is presented by G. W. Washa, professor of mechanics, University of Wisconsin, Madison, and N. H. Withey, consulting engineer, Chicago Fly Ash Co., Chicago, Ill.

Professor Washa is the author of numerous ACI papers. He received the Wason Medal for noteworthy research for work reported in his 1940 paper, "Comparison of the Physical and Mechanical Properties of Hand-Rodded and Vibrated Concrete Made with Different Cements."

He was a member of the ACI Board of Direction, 1948-50; and is now chairman of Committee 213, Properties of Lightweight Aggregate Concrete; secretary of Committee 115, Research; and a member of Committee 609, Vibration of Concrete.

Professor Washa graduated from the University of Wisconsin in 1930 with a BS in civil engineering and received his PhD from the same university in 1938. He has been actively engaged in research work for many years at the university. Professor Washa has been an ACI member since 1940.

Mr. Withey, in addition to his duties as consulting engineer for the Chicago Fly Ash Co., is president, Norman Withey and Co., Inc., Madison, Wis.

After receiving a BS degree in civil engineering from the University of Wisconsin, he engaged in civil engineering work in both research and construction. In 1933 he joined the staff of the Portland Cement Assn. as a research engineer where he was employed for 10 years. Here his duties involved the conduct of physical research and development, chiefly durability studies and tests, and the investigation of air-entraining agents. While with PCA he also did considerable field work on numerous experimental concrete road projects.

After war work at the Forest Products Laboratory, Madison, Wis., in which he was occupied in developing projects for the Army Ordnance, he became concrete research engineer in 1946 for the Alpha Portland Cement Co., in charge of the research and testing laboratory. Mr. Withey also had been associated with Newport Industries, Inc., producers of naval stores. In addition to being an ACI member since 1939, he is a member of ASTM.

Fred Hubbard

Fred Hubbard, director of research, National Slag Assn., Washington, D. C., discusses "Production of Commercial Blast Furnace Slag," p. 713.

During the early part of Mr. Hubbard's career he was employed by the Carnegie Steel Co. as field engineer and superintendent of construction. Here he had his first introduction to the use of blast furnace slag, primarily as an aggregate for portland cement concrete used as heavy steel mill foundations. During World War I he was chief field engineer and superintendent of construction for the government ordnance plant which was to have been built on Neville Island, Pa. The project was discontinued before completion at the signing of the armistice.

In 1925 he joined the staff of the Standard Slag Co. and since then has devoted his entire time to the development and promotion of blast furnace slag as a commercial aggregate. For many years he has served as director of research for the National Slag Assn. and also as consulting engineer for a number of large slag producing companies.

Mr. Hubbard is a registered engineer and has been an ACI member since 1926. He was a member of the ACI Board of Direction, 1943-1944.

George L. Otterson and Woodrow L. Burgess

George L. Otterson and Woodrow L. Burgess team up to make their first JOURNAL contribution with "Recent Changes in Corps of Engineers Concrete Construction Specifications," p. 721. It is not their first endeavor as a team. In addition to their present work in the Office, Chief of Engineers, Washington, D. C., they were associated in the construction of Bull Shoals Dam in Arkansas, where Mr. Otterson was in charge of construction operations and Mr. Burgess was his assistant in charge of concrete control testing.

Mr. Otterson, assistant chief, Concrete Control Branch, Office, Chief of Engineers, Corps of Engineers, participated in drafting the new guide specifications.

Mr. Otterson received his civil engineering training at the University of Minnesota and entered the employ of the Corps of Engineers in 1930. He has served as a concrete technician and construction supervisor on widely diverse types of concrete construction, and has been responsible for the planning and direction of concrete materials investigations for several projects including Bull Shoals Dam. During 1941 and 1942 he was employed by the Panama Canal Commission for the investigation of concrete and concrete materials for the third locks.

A lieutenant colonel in the U. S. Army Reserve, he served in the European Theater during World War II. Part of his present duties consist of coordinating the activities of the seven division laboratories of the Corps of Engineers. Mr. Otterson, ACI member since 1941, is a member of the Technical Committee for Lime, Cement, and Plaster of the Federal Specifications Board.

Mr. Burgess, now a technical assistant, Concrete Control Branch, Office, Chief of Engineers, was graduated in mining engineering from the Missouri School of Mines. He entered the employ of the Corps of Engineers in 1941 and until his present assignment his work has been almost continuously at the project level. In addition to Bull Shoals Dam, these projects have included Clearwater Dam in Missouri; Norfolk Dam in Arkansas; Barksdale Air Base in Louisiana; and Detroit Dam in Oregon. For a period of one year Mr. Burgess was assigned to the North Pacific Division Laboratory, Corps of Engineers, Portland, Ore. An ACI member since 1948, he is also a member of Tau Beta Pi.

D. Watstein

"Effect of Straining Rate on the Compressive Strength and Elastic Properties of Concrete," p. 729, is described by D. Watstein, assistant chief, Structural Engineering Section, National Bureau of Standards, Washington, D. C.

Mr. Watstein graduated from the University of California in 1930 with a BS degree in civil engineering, and joined the staff of the Cement Section, National Bureau of Standards, in physical testing of cements and concrete. While with the Masonry Construction Section of the Bureau, he made tests of masonry materials and engaged in several research projects which included permeability of masonry walls, strength of brick and tile walls, and study of limes in masonry mortars. Mr. Watstein has been an ACI member since 1941.

Committee 716

"Physical Properties of High-Pressure Steam-Cured Concrete Block," p. 745, is a progress report of ACI Committee 716, High-Pressure Steam Curing, W. C. Hansen, chairman.

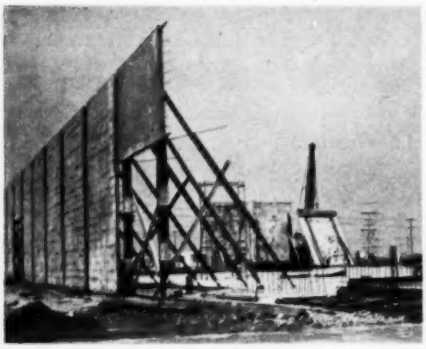
In this report three methods for determining drying shrinkage of high-pressure steam-cured concrete block are described and results are compared.

Crandall heads Boston engineers

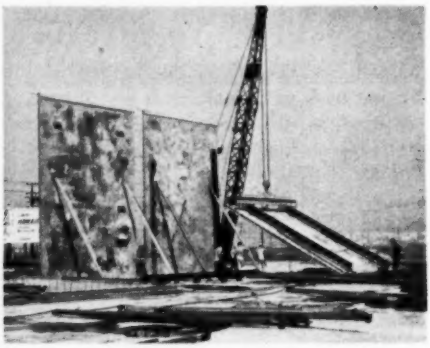
J. Stuart Crandall, consulting engineer, Crandall Dry Dock Engineers, Cambridge, Mass., was elected president of the Boston Society of Civil Engineers at its 105th anniversary meeting March 18.

Daymude retires

Charles A. Daymude recently retired as chief of the Bureau of Structural Engineering, Department of Buildings and Safety Engineering, Detroit, Mich., after 35 years of service with the bureau.



Strong and upright—With openings left for doorways, the concrete slabs were swiftly tilted into position. Forty-eight 20 x 28 ft slabs were erected—on the best day's work 13 were erected



Up they go—The 6 in. thick wall slabs were cast in molds directly at the point for hoisting. The 19-ton units were crane-hoisted into place, the lifting yoke being attached at four places

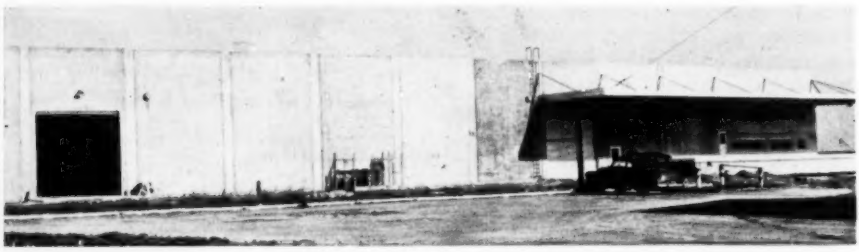
Tilt-up construction cuts cost on airline warehouse

Concrete tilt-up wall construction recently cut 5 percent from over-all costs and saved at least 30 days in building a warehouse at the San Francisco maintenance base of United Air Lines, according to W. E. Ottenstein, the company's assistant manager of construction and maintenance.

The warehouse was built by Barrett and Hilp, San Francisco contractors, and designed by H. J. Brunnier. First, an area 200 ft wide and 280 ft long was leveled and covered with a concrete floor. Forty-eight slabs, 20 x 28 ft and 6 in. thick, were then cast on the floor. The forms were made of 8-in. headboard. Reinforcing rods were permitted to protrude about a foot on the shorter sides.

When the slabs had hardened, a lifting yoke was attached at four places by means of bolts screwed into nuts which had been welded to the reinforcing steel mat. The slabs then were hoisted by a crane and set 18 in. apart. Each slab weighed 19 tons. On the best day's work, 13 were erected. After the wall slabs were upright, 28 ft high plywood forms were placed at the 18-in. openings. Concrete was placed in the forms by bucket and vibrated to prevent lumping or honeycombing.

A separate structural frame of conventional truss design was built inside the slab walls, with columns for roof support every 40 ft. "Pyrofil" was used for the cast-in-place roof. The completed warehouse provides 56,000 ft of storage space for some 53,000 kinds of aircraft parts and supplies used in maintaining United's fleet of Mainliners.



Ready for service—Tilt-up wall slabs 28 ft high were used in United Air Lines' new maintenance warehouse in San Francisco

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BOSTON — NEW YORK

Quirin heads new firm

Baker and Spencer, Inc., New York consultants, have announced their affiliation with Frederic R. Harris, Inc., New York. Edward J. Quirin, president of the Harris firm, will become head of the new company.

Rea accepts position

Robert F. Rea, formerly technical service manager, Zonolite Co., Chicago, Ill., is now director of ceramic research, Stupakoff Ceramics and Mfg. Co., Latrobe, Pa.

Cain appointed vice-president

Craig J. Cain, until recently manager, Combustion By-Products Co., Chicago, Ill., is now vice-president, Continental Concrete Pipe Corp.

Frolich named vice-president

A. K. Frolich, formerly chief engineer, Ash Grove Lime and Portland Cement Co., Kansas City, Mo., has been named vice-president.

Mr. Frolich joined the company as a structural engineer in 1924 and supervised construction of the plant in Louisville, Nebr., where he was superintendent until 1945 when he was made chief engineer with headquarters in Kansas City. Mr. Frolich is a graduate of Thueringishes Technical College, Ilmenau, Germany.

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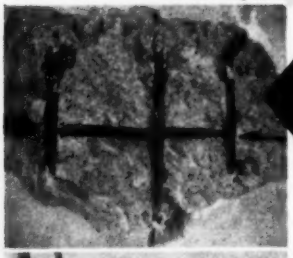

Typical example of spalling. Note corrosion of reinforcing rods exposed by disintegrating concrete.

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Ray V. Warren

Ray V. Warren, executive secretary and engineering representative of the Western Pennsylvania Sand and Gravel Assn., Pittsburgh, Pa., since its formation in 1929, died recently. He held the same position in the Ready-Mixed Concrete Assn. of metropolitan Pittsburgh since its formation in 1933. Mr. Warren also served as secretary-treasurer of the Pennsylvania Department of Highways and also served several years as road commissioner of Allegheny county.

Mr. Warren was an associate member of ASCE and had been an ACI member since 1930.

Clement T. Wiskocil

Clement T. Wiskocil, professor of civil engineering, University of California, Berkeley, died recently. An ACI member since 1935, Professor Wiskocil also had been affiliated with numerous other engineering societies. He was a past chairman of the Pacific Southwest Section of ASEE, and past president of the San Francisco Section of ASCE. A graduate of the University of Wisconsin, he was on the faculty of the College of Engineering, University of California, for the past 38 years.

Recognized as an outstanding teacher in civil engineering subjects, and a friend and counsellor of the students, he was particularly interested in engineering ethics, serving for many years as faculty adviser to certain of the honor societies and student engineering chapters. Professor Wiskocil also was co-author of the book, "*Testing and Inspection of Engineering Materials.*"

Sturdy elected president

Howard H. Sturdy, vice-president, Dravo Corp., Pittsburgh, Pa., was recently elected president of the Constructors Assn. of Western Pennsylvania.

MacNider elected to Board

Tom MacNider has been elected to the board of directors of Northwestern States Portland Cement Co., Mason City, Iowa. He was also named assistant to the president.

Concrete Profits from Stearns

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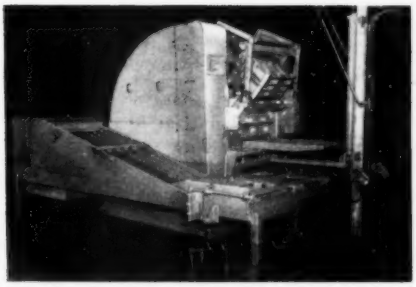
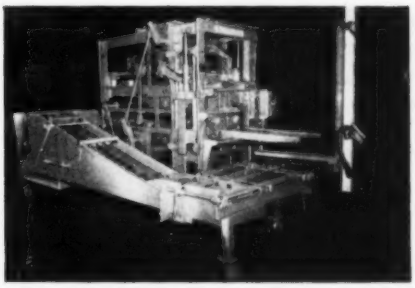


STEARNS 15 — For the Larger Plant. Fully automatic. One-man operation. Plain pallets. Power pallet handling. 12-18 eight-inch units per minute, three blocks per cycle. High production and uniform density of units, top to bottom, made possible by Stearns Dual Shaft Vibration under Pressure.



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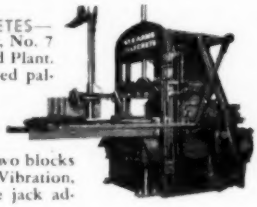

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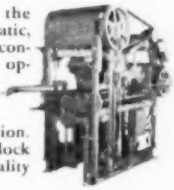

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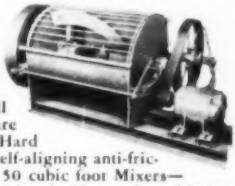

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Maryland's first prestressed concrete bridge

Another highway department joined the ranks of those building with prestressed concrete when the Maryland State Roads Commission awarded a contract in late October of 1952 for a 100-ft single span prestressed concrete bridge, the first of its kind in the history of the state. The structure is to carry the Baltimore-Harrisburg Expressway over Shawan Road, about one mile west of Marble Hill in Baltimore county. Bonwit Construction Co., Inc., New York City, was awarded the contract on a low bid of $77,400 covering the entire construction, and started work in early November.

Plans prepared under the supervision of Albert L. Grubb, engineer of bridge design for the state roads commission, call for nine prestressed concrete T-shaped girders placed side by side with a small space between the top flanges, later to be filled with cast-in-place concrete. The girders will support a 30-ft clear roadway with a 3 ft 1 in. wide sidewalk on one side and a 1 ft 7 in. wide safety curb on the opposite side.

The bridge is designed to support the maximum highway loading in accordance with the American Assn. of State Highway Officials Standard Specifications for Highway Bridges. The Bureau of Public Roads Design Criteria for Prestressed Concrete was the basis for designing the prestressed concrete girders.

Girders

The girders have a T-shaped cross section (Fig. 1) with a uniform 60-in. depth, which is 1/20 of the span length. The top flange is 44 in. wide and varies in thickness from 9 in. at the junction with the web to 7 in. at the outer ends. The bottom flange is 20 in. wide and 6 in. thick. The web is 8 in. thick, except at either end where it is as wide as the bottom flange to form a solid block for the end anchorages. The girders rest on two reinforced concrete abutments which in turn are supported on 14 steel bearing piles (Fig. 2).

All girders are to be cast and cured, and prestressed only after the concrete has developed a 4000 psi compressive strength as determined by standard 6 x 12-in. test cylinders. The girders will then be post-tensioned by means of 16 cables, each of which contains 12 high tensile strength steel wires of 0.196-in. diameter. The cables are placed in the girders before concreting and are protected with flexible metallic hose; this sheath prevents concrete from bonding with the wires. When the cables are stressed and anchored, a liquid grout is forced into the tubes and around the wires to protect them from the elements and to provide a bond with the concrete. The cables when placed are draped in a parabolic curve with all as near the bottom of the girder as possible at midspan and spreading upward at each end. The cables are also placed symmetrically through the girder cross section so that no unequal prestress force will cause a girder to bow sideways.

Specifications call for the wire to have a minimum ultimate strength of 220,000 psi. Initial prestress or tensioning force on each cable amounts to 47,800 lb, or a unit stress of 132,000 psi. The total force required to prestress the 16 cables in a girder is slightly in excess of 380 tons. The end anchorages to be used will be those manufactured by the Freyssinet Co., and when all cables are securely fastened after stressing, the anchorages are to be encased in concrete.

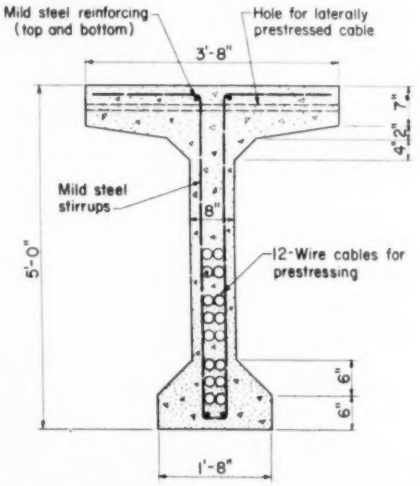
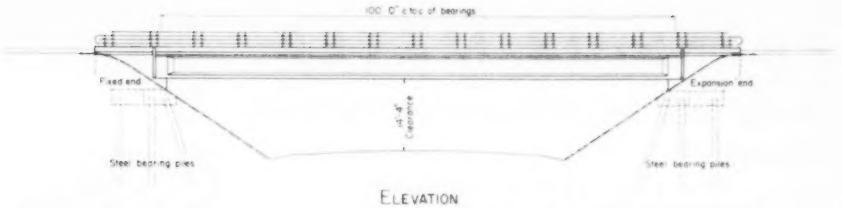


Fig. 1—Typical section through prestressed girder



ELEVATION

Fig. 2—Single span 100-ft prestressed concrete bridge will be prestressed both longitudinally and transversely

In addition to the high tensile strength steel wire, the girders are reinforced with ½-in. diameter U-shaped mild steel stirrups spaced throughout the length of the girder, plus extra mild steel reinforcement at the supports.

Lateral prestressing

The girders are stiffened at each end, at the quarter-points, and at midspan with concrete diaphragms cast integrally with the main structural bridge members. These stiffeners are 8 in. thick and extend vertically between the girder flanges and outward from the web until they are in a vertical line with the edge of the top flange. Holes are formed in these diaphragms as well as in the top flanges of the girders through which cables are later threaded transverse to the direction of the bridge span (Fig. 3). These cables are also prestressed to hold the girders together and help spread concentrated deck loads to more than one girder. There are 20 such cables in the top flanges, spaced 4 ft 10 in. apart, three in each intermediate stiffener and two in the end blocks. The same prestress force and anchorage units are used as in the longitudinal prestressing.

When the girders are placed on the abutments, a 5¼-in. space will exist between the adjoining diaphragms and top flanges. This space is to be filled with cast-in-place concrete of a quality specified for the girder concrete. Lateral prestressing will proceed only after this fill-in material has hardened to 4000 psi.

Concrete

Concrete for the prestressed girders, diaphragms, and the end anchorage encasement has been specified for a minimum 5000 psi compressive strength at 21 days, a maximum 2½-in. slump, a maximum ¾-in. size coarse aggregate conforming to the state road commission's specifications size No. 7, a fine aggregate as specified for their Type A concrete sand, and a minimum of 8½ sacks of portland cement per cu yd of concrete. Concrete for the abutments, safety curbs, and sidewalks is specified to be a state road commission's Class A concrete with Type Ia portland cement. Specifications call for the grout to be 1.3 parts of portland cement, 0.7 part sand not greater than 1/64 in. grain size, and 1.0 part water. Forms for the girders are to be constructed with a plywood inner surface.

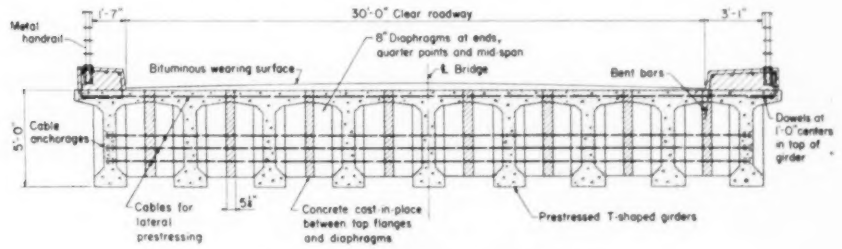


Fig. 3—Typical section through bridge

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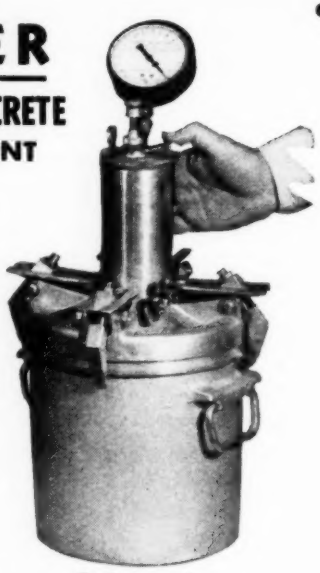

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New Members

The Board of Direction approved 65 Individual, 1 Corporation, 11 Junior and 7 Student Members for February. With adjustments for losses, resignations and non-payment of dues, the total membership was 6054 on February 1.

Individual

BEAUCHEMIN, JACQUES, Montreal, Canada (Tech. Repres., Ciment Fondu Lafarge (Canada) Ltd.)

BEHR, HARRY C. A., Arlington, Mass. (Mfg. Repres., Sales Engr., Flexicore Prestressed)

BICKNELL, WALTER H., Denver, Colo. (Chief Arch. Draftsman, Reg. Prof. Eng., The Mountain States Tel. & Tel. Co.)

BILLINGTON, JOHN C., Birmingham, England (Struct. Eng., City of Birmingham)

BLISS, RODERICK A., SR., Folsom, Calif. (Lab. Testing, Supt. Insp., USBR)

BOESCH, JOHN, Flushing, N. Y. (Struct. Eng., Designer, Esso Standard Oil Co.)

BOND, KENNETH A., Sidney, Australia (Cons. Struct. Engr., Partner, Woolacott, Hale & Bond)

CHEN, TSUNG-WEN, Denver, Colo. (Deputy Engr., Taiwan Power Co.)

CHRISTENSEN, OTTO S. L., Copenhagen, Denmark (C. E., Contr.)

CLINE, FRED F., Los Banos, Calif. (Genl. Constr. Insp., USBR)

CODE, RALPH J., Roxbury, Mass. (Civil & Matls. Engr.)

DEMIRE, HAIG A., Highland Park, Mich. (Engr. & Arch., Giffels & Vallet, Inc.)

DHIR, P. L., Ferozepore, India (Sub Divisional Officer, Govt. of India)

DIGNUM, NORMAN J., Miami Fla. (Cons. Engr.-Struct.)

DOHERTY, RICHARD, Chicago, Ill. (Research Tech., American Bildrok Co.)

DORAIS, MARCEL, Sillery, Canada (Super. Estimating & Job Management, Chrysanthe Jobin Ltd., C. E.)

DOUGLAS, MALCOLM S., Cleveland, Ohio (Exec. Secy., City of Cleveland)

ERICKSON, DONALD A., Minneapolis, Minn. (Bldg. Inspector, City of Minneapolis)

ESTRADA, MARCO, Denver, Colo. (Designing & Supervision, Institute Nacional de Fomento Municipal)

FILIPPI, HUGO, Chicago, Ill. (V. P., Secy., C. E., Illinois Brick Co.)

FLEMING, LT. JOHN VINCENT, Washington, D. C. (Program Coördinator, U. S. Navy)

GARNEAU, J. B., Quebec, Canada (Chf. of Lab., Province of Quebec)

GERDINE, LOUIS A., San Francisco, Calif. (Regional Engr., Intrusion-Prepakt, Inc.)

GREEN, NORMAN B., Los Angeles, Calif. (Cons. Struct. Engr.)

GRUENWALD, OTTO, New York, N. Y. (Cons. Engr., Roberts & Schaefer Co.)

HANKE, ALVIN A., Cleveland, Ohio (Supervising Engr., of Struct. Design, Cleveland Electric Illuminating Co.)

HANNAS, O. J., Green Bay, Wis. (Supt. Constr. Engr., Wisconsin Public Service Corp.)

HAYNES, BEN F., Denver, Colo. (Urban Matls. Engr., Supt. of Testing, Colo. Dept. of Highways)

HICKLIN, WILLIAM J., JR., Jacksonville, Fla.

Continued on p. 49

Membership in the American Concrete Institute

If this issue of the ACI JOURNAL has been of interest and useful in your work and you are not already a member, assure yourself of receiving it regularly by completing and sending in the membership application form below. The grades of membership are described overleaf.

All who have an interest in concrete and a desire to improve it through a nonprofit educational service in gathering, correlating, and disseminating information on design, construction, manufacture, use, and maintenance of concrete structures and products are eligible for Institute membership.

There are many opportunities in the Institute for technical committee activity, contributions from your experience in technical papers and the briefer "Letters from Readers" section, and in reviewing technical literature. Thus you can help further ACI's aim "to provide a comradeship in finding the best ways to do concrete work of all kinds and in spreading that knowledge," and at the same time benefit from the experiences of other Members.

(cut here)

Board of Direction, American Concrete Institute
18263 W. McNichols Road
Detroit 19, Michigan

Date_____

Individual Members, North America and U. S. Possessions	**$15.00**
Individual Members elsewhere	**12.00**
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(Subject to stipulations of Bylaws—Article I on reverse side. Bylaws on request.)

Of the annual dues, $12.00 is for the JOURNAL of the American Concrete Institute (except that dues for Junior and Student Members apply in full for the JOURNAL).

The undersigned hereby applies for _____ **membership**
(Individual, Corporation, Contributing, Junior, Student)

in the American Concrete Institute. Proposed by_____

For Corporation Membership, ACI representative will be_____

_____ _____
(Date of graduation if Student) (Name, if Corporation)

Signature_____

For our records, please complete both sides of application.

EXCERPTS FROM BYLAWS: ARTICLE I—MEMBERS

Section 1. This Institute shall consist of Members, Corporation Members, Contributing Members, Junior Members, Student Members and Honorary Members interested in furthering the Institute's objects as set forth in its Charter.

Sec. 2. A Member shall be an individual.

A Corporation Member shall be a firm, corporation, society, agency of government or other organization. A Corporation Member shall name one individual as its representative who will enjoy all membership rights and privileges.

A Contributing Member shall be an individual, firm, corporation, society, agency of government or other organization wishing to give larger support to Institute activities through the payment of larger dues. Contributing Members, other than individuals, shall name representatives as do Corporation Members.

A Junior Member shall be a person less than 28 years old.

A Student Member shall be less than 28 years old and a student in residence at a recognized technical or engineering school.

An Honorary Member shall be a person of eminence in the field of the Institute's interest, or one who has performed extraordinarily meritorious service to the Institute.

Sec. 3. All classes of Members except Honorary Members and Student Members, shall be proposed by at least one Member of the Institute and elected by a two-thirds vote of the Board of Direction. An Honorary Member shall be elected by unanimous vote of the Board of Direction. A Student Member shall be proposed by a member of his school's faculty, who need not be a Member of the Institute, and elected by a two-thirds vote of the Board of Direction.

Sec. 4. All Members shall have all rights and privileges of membership as determined by the Board of Direction except that a Junior or Student Member shall not vote nor hold office. The status of a Student Member shall change automatically to that of Junior Member on the first anniversary of his membership succeeding the date on which he ceases to be a student in residence. The status of a Junior Member shall be changed to that of Member on the first anniversary of his membership after he becomes 28 years of age.

Sec. 5. Applications for and resignations from Membership and requests for change of representatives of Corporation or Contributing Memberships shall be presented in writing to the Secretary-Treasurer. Resignations may be accepted only from Members whose dues are not more than 60 days in arrears, except by special action of the Board of Direction.

(cut here)

Date of Birth _____
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New Members

Continued from p. 46

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HOLCOMB, ROBERT M., College Station, Texas (Teacher, Struct. Engrg. Design, A. & M. College of Texas)
HORNBY, PAUL L., Knoxville, Tenn. (C. E., TVA)
JENKINS, GEORGE S., Albany, Ga. (Asst. Proj. Mgr., J. E. Greiner Co.)
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LYTELL, BERNARD L., Drayton Plains, Mich. (Pres. & Mgr., Lytell & Colegrove, Inc.,)
MACPHERSON, DONALD R., New York, N. Y. (Senior Staff Engr., Johns-Manville Products Corp.)
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MARKS, JOSEPH D., Mariemont, Ohio (Matls. Engr., Corps. of Engineers)
MEEKER, EDWARD E., Indianapolis, Ind. (Pres., Chf. Engr., M & M Engrg. Corp.)
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PARIS, GEORGE H., Chicago, Ill. (Struct. Engr., PCA)
POE, STEPHEN H., Denver, Colo. (Engr., Technical Editor, USBR)
PONTIUS, FRANKLIN S., Berea, Ohio (Bldg. Constr. Eng., Leo W. Schmidt Co.)
RICE, JAMES M., Washington, D. C. (Research, Testing Engr., National Crushed Stone Assn.)
ROHR, WILLIAM GIPSON, Toledo, Ohio (Plant Engr., Columbia Concrete Products Co.; Research Engr. Univ. of Toledo)
SAKAKCENY, ANTHONY, Allston, Mass. (Designing & Supt. of Drafting, Goldberg Le Mossurier & Assoc.)
SANDONA, BRUNO, Chicago, Ill. (Designing, Drafting, Johnson & Johnson)
SCHULZ, WERNER L., Arapahoe, Nebr. (Constr. & Maint., USBR)
SEEGER, O. H., Columbus, Ohio (Genl. Mgr., Harry Wellnitz Co.)
SHAY, EVAN M., Los Angeles, Calif. (Chf. Lab. & Field Engr., O. J. Porter & Co.)
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SNIKERIS, ERNEST V. O., St. John's, Canada, (Res. Engr., Province of Newfoundland)
SPEARS, RALPH E., Salt Lake City, Utah (Dist. Engr., PCA)
STELZLE, ROBERT C., Williamstown, W. Va. (Mgr. of Wall Panel Plant, Marietta Concrete Corp.)
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Honor Roll

February 1—February 28, 1953

The Honor Roll for the current year begins this month. Elmo C. Higginson and Walter H. Price are tied for first place with four and a half credits each. Henry L. Kennedy is second with two credits.

New members mean new ideas—by increasing the membership in ACI you not only share your knowledge, but gain many important facts from others.

Elmo C. Higginson	4½
Walter H. Price	4½
Henry L. Kennedy	2

Jacoby acts as engineering director

Gordon C. Jacoby, following the dissolution of the consulting engineering firm of Jacoby-McGrayne and Co., Hackensack, N. J., of which he was one of the principals, will act as engineering director of the Alexander Summer Industrial Service Co., Teaneck and Newark, N. J.

McAlpine retires

W. H. McAlpine retired recently as special assistant to the Chief of Engineers, Washington, D. C., after 50 years with the Army Corps of Engineers. Mr. McAlpine, ACI member since 1950, is an international authority on construction of dams, reservoirs, and levees. During his career he has been district engineer at Louisville, Ky., and St. Louis, and has been special assistant in Washington since 1934.

Tools, Materials, Services

Under this heading note will be made from time to time of producer literature of presumed technical interest (and available from its source for the asking) to ACI users of tools, equipment, materials, accessories and special services.

Masonry saw

A lightweight, portable tubular masonry saw, called the Tak-A-Bout, has been announced by Champion Manufacturing Co. The all welded machine is primarily built of aircraft tubular steel. In the 14-in. blade capacity models it is equipped with a 1½-hp motor, while the 12-in. blade capacity models have 1-hp motors.

Four models are being produced, one 14-in., and one 12-in. blade capacity models, designed for wet or dry cutting; the other 14-in. and 12-in. models are for dry cutting. The dry cutting models can be converted to wet cutting, by the addition of a "conversion" kit.—Champion Manufacturing Co., 2028 Washington Ave., St. Louis, Mo.

Engineering film

Dravo Corp. has completed a 30-min., 16-mm sound film, "Portrait of an Enterprise," in color documenting many of the firm's diversified activities serving nearly every segment of industry. In the film are on-the-job scenes of heavy construction projects, river locks, dams, bridges. Also included are riverboat and barge construction and launchings, and operation of large ore unloaders. Production and distribution of river sand and gravel are highlighted in other sequences. Construction of a central station power plant and a gas transmission line compressor station are depicted. The film is available without charge for showing to engineering groups, schools and colleges, and other interested organizations.—Advertising Department, Dravo Corp., Neville Island, Pittsburgh 25, Pa.

Portable air compressor

Development of a 75-cfm portable air compressor for standby service or direct production jobs has been announced by the O. K. Clutch & Machinery Co. Known as the Hornet "75," it will handle the same work as the company's present 85-cfm model, and approximately twice as much work as the company's present 60-cfm model.

The unit uses a 6-cylinder Chrysler engine which has been rebuilt for compressor service. Power from three cylinders of the engine are used for air compression and the other three for power. Tests have shown that the new model will handle a 45-lb paving breaker, a 45-lb rock drill, or two backfill tampers, or two clay spades, or two riveting guns, or any combination of two small tools.—O.K. Clutch & Machinery Co., Florence St., Columbia, Pa.

Valves

Bulletin 1000, describing and illustrating the complete line of Ledeen valves has been released by Ledeen Manufacturing Co. The bulletin includes illustrations, operating and circuit diagrams, and dimensions and weights. Ledeen valves embodying disc type construction, are used for operating air and hydraulic cylinders, single and double acting, and air motors. They are available in hand, foot, power, and solenoid operated models.—Ledeen Manufacturing Co., 1600 S. San Pedro St., Los Angeles 15, Calif.

Pressure pipe check sheet

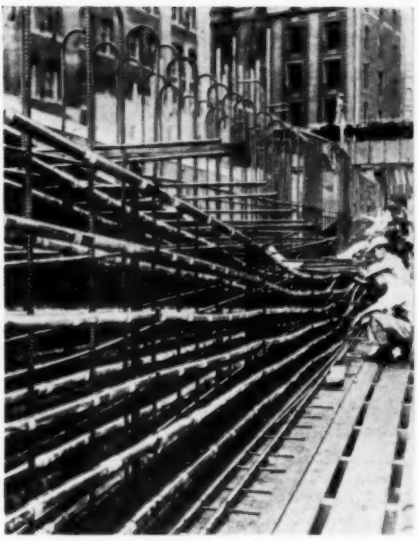
A four-page folder, published by Price Brothers Co., lists all of the requirements for proposed water supply lines in simple question and answer style. Answers, showing how prestressed concrete pipe meets these requirements, are given for all the questions.—Price Brothers Co., 1932 East Monument Ave., Dayton 1, Ohio

Surface treatment of concrete for radiation shielding

An unusual problem of surface treatment of concrete was encountered in providing concrete shields for the giant cosmotron at Brookhaven National Laboratory, Upton, N. Y. The $8,000,000 cosmotron is shielded for more than 100 ft around its circumference by a series of 10-ton concrete blocks stacked four tiers high. The blocks protect scientists working at controls and experimental equipment from radiation emanating from the cosmotron during operation.

Because the cosmotron is a delicate piece of machinery, it is necessary to keep the 200 ft long room virtually dust-free. One of the problems is preventing the concrete shielding blocks, which are occasionally moved, from causing dust. The problem was reportedly solved by using Vibrin polyester resin, a product of the Naugatuck Chemical Div., United States Rubber Co. A $\frac{1}{32}$-in. coating seals the concrete block with a hard, glasslike surface, thus eliminating the concrete dust problem.

Standard compresser equipment was used to apply the coating. At Brookhaven, the Vibrin was extended with calcium carbonate and a pigment was also added to give the blocks a grey color.—United States Rubber Co., Rockefeller Center, New York 20, N. Y.



Plastic tubing for cables in prestressed concrete

One of the problems in connection with installation of prestressed concrete is the type of protection which must be given tensioning cables or rods to prevent adherence of concrete and provide a friction-free covering at the same time. Various combinations of paper and tape coverings have been used, and a new development is Aeroflex plastic tubing, developed by Anchor Plastics Co., Inc., with the cooperation of John A. Roebling's Sons Co., wire rope specialists.

Aeroflex split tubing is available in 10-ft random lengths to fit snugly over cable or rods in diameter sizes from ¾ in. up. Wall thicknesses vary from 0.030 to 0.040 in., depending upon diameter size. A ½-in. overlap, faced with interlocking longitudinal corrugations, combines with the natural springiness of the plastic tubing to prevent concrete mix from seeping inside to lodge in the interstices between cable wires.

To apply the plastic tubing to a greased strand or rod, the workman spreads the end open and places it on the tensioning member. Then, by running his thumb along the longitudinal split to open it, he walks along the strand, feeding the tubing in place. Masking tape, 1½ or 2 in. wide, is then placed along the longitudinal overlap and fastened around the tubing on 1½- or 2-ft centers.

To date the tubing has been used on several outstanding prestressed concrete structures, latest of which is the Barrett-Lick garage in San Francisco, Calif. Other jobs include a bridge for the Texas State Highway Department, a U. S. Navy rocket launching project, and the Burma Bridge in the state of Washington. "Aeroflex Plastic Tubing for Prestressed Concrete," an illustrated folder, gives specifications and information about the plastic split tubing.—Anchor Plastics Co., Inc., 36-36 36th St., Long Island City 6, N. Y.

Pneumatically-placed vermiculite concrete

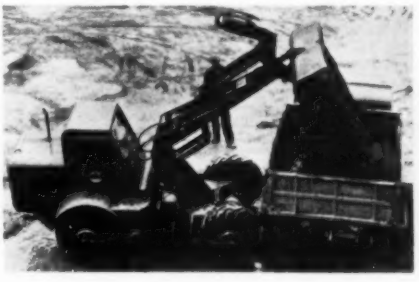
Pneumatically-placed vermiculite concrete, called "Blocrete," was recently used for fireproofing a hotel elevator shaft in Spokane, Wash. To meet a municipal 4-hr fire rating, two coats of this material were blown on walls of the shaft. Blocrete was applied 3½ in. thick as the plasterers worked their way up the seven-story shaft. A second coat ½ in. thick was blown on as they descended. No finish was applied because the concrete was sufficiently smooth.—Zonolite Co., 135 S. LaSalle St., Chicago 3, Ill.

Concrete pipe laying

A pipe-laying instruction booklet, released by Price Brothers Co., tells workmen how to lay concrete pressure pipe; nontechnical language explains each step and each operation carries a "how-to" photograph. There are no complicated diagrams; only simplified sketches of equipment.—Price Brothers Co., Pressure Pipe Division, Dayton 1, Ohio

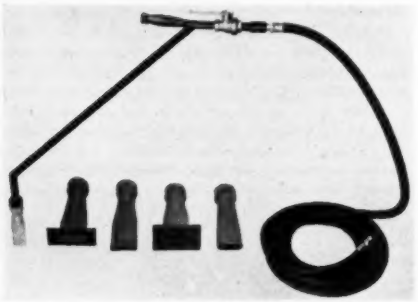
Portable crushing plants

A new line of single pass, portable crushing plants has been announced by Diamond Iron Works, Inc. Called the "100 Series," the three plants have capacities from 30 to 70 tph. Each plant has a 1½-deck oversize vibrating screen and roller bearing jaw crusher. No. 116 has a 10 x 16-in; No. 120 a 10 x 20-in.; and No. 124 a 10 x 24-in. jaw crusher. Capacities based on 25 percent oversize passing a 1-in. screen are: No. 116—30/40; No. 120—40/55; and No. 124—55/70 tph. — Diamond Iron Works, Inc., 1748 N. 2nd St., Minneapolis 11, Minn.



Front-end loader

Two new four-wheel planetary drive, four-wheel power steering front-end loaders, the Scoopmobile Models LD5 and LD10, have been announced by Mixermobile Manufacturers, Inc. The LD5 capacity is ¾ to 1 cu yd, LD10 capacity is 1⅝ to 2 cu yd. These units are said to employ a new principle of construction by hinging two power axle elements together with an oscillating center-pin steering coupling. This coupling allows an oscillating twist to the axles, retaining full power on all four wheels in any degree of the turning radius. Power from the engine is transmitted to all wheels through 3-to-1 planetary gearing. The loading bucket is hydraulically operated and discharge height of the LD5 is 8 ft 6 in.; LD10, 9 ft.—Mixermobile Manufacturers, Inc., 8027 N. E. Killingsworth St., Portland 20, Ore.

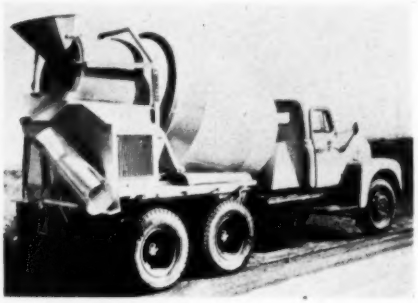


Joint sealing compound applicator

A new easy to handle applicator for installing sealing compounds in joints and cracks in concrete and asphalt construction has been announced by Phillips Products, Inc. The applicator was developed to answer the need for equipment to apply the ready-mixed, cold-applied sealers that are now in the specifications of highway departments of several states. Outstanding feature of the Phillips No. 77 joint sealing compound applicator is its conveniently located flow-control valve. A set of three nozzles is furnished with each applicator. These are in widths of ¼-in. for contraction joints, ⅜-in. for contraction and construction joints, and ½-in. for expansion joints. Two other nozzles are available, a ⅛-in. width for sawed joints and a special nozzle for maintenance sealing.—Phillips Products, Inc., 1442 West Tenth St., Cleveland 13, Ohio.

Reflective curing paper

A new curing blanket for concrete has been developed by The Sisalkraft Co. to aid in preventing excessive heat on the slab surface as well as retain sufficient moisture during the early period of hydration. This reinforced curing paper is bleached white on one side to reflect solar heat which, when applied to the slab, is said to bring more into balance these temperature variations. The blankets are available in any width up to 26½ ft, and under ordinary job conditions and a 72-hr curing period, the blankets can be re-used a minimum of 15 times.—The Sisalkraft Co., 205 W. Wacker Drive, Chicago 6, Ill.



Concrete transit mixer

A new 6- to 7¼-cu yd concrete mixer has been announced by Willard Concrete Machinery Sales Co., with movement of the center of gravity to a point which is said to allow greater payloads while still maintaining legal distribution of the weight on the truck's axles.

This big mixer is suitable for mounting on ten-wheel trucks with 175-in. wheelbase. Power for the drum is furnished by a transverse-mounted, 93-hp Ford OHV Industrial 6 and basic Ford power transmission assembly. Over-all gear ratio through the transmission and final chain drive is 281 to 1. With the engine in the rear, the main weight of the concrete is thrown far forward to equalize axle loads. Both charging and discharging hoppers are designed with large collecting areas. The folding chute is made of ⅜-in. steel and extends 8 ft 6 in. from the swivel center.—Willard Concrete Machinery Sales Co., 11700 Wright Rd., Lynwood, Calif.

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